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THE
WISDOM of GOD
Manifeſted in the
WORKS
OF THE
CREATION.

In TWO PARTS.

VIZ.

The Heavenly Bodies, Elements, Meteors, Foſſils, Vegetables, Animals, (Beaſts, Birds, Fiſhes, and Inſects); more particularly in the Body of the Earth, its Figure, Motion, and Conſiſtency; and in the admirable Structure of the Bodies of Man, and other Animals; as alſo in their Generation, *&c.* With Anſwers to ſome Objections.

By *JOHN RAY*, late Fellow
of the *Royal Society*.

The EIGHTH EDITION, Corrected.

LONDON,
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to the *Royal Society*, at the Weſt-End of St. *Paul*'s.
MDCCXXII.

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TO THE
Much Honoured and Truly Religious
LADY,
THE
Lady LETTICE WENDY,
OF
Wendy in *Cambridgeſhire.*

MADAM,

TWO or Three Reaſons induce me to preſent this Diſcourſe to Your Ladyſhip, and to make Choice of You for its Patroneſs: *Firſt*, Becauſe I owe it to the Liberality of Your honoured Brother, that I have this Leiſure to write any Thing. *Secondly*, Becauſe alſo

Your many and ſignal Favours, ſeeing I am not in a Capacity to requite them, ſeem to exact from me at leaſt a publick Acknowledgment, which ſuch a Dedication gives me an Opportunity to make. *Thirdly*, Becauſe of ſuch Kind of Writings, I know not where to chooſe a more able Judge, or more candid Reader. I am ſenſible that You do ſo much abhor any Thing that looks like Flattery, that out of an Exceſs of Modeſty, You cannot patiently bear the Hearing of Your own juſt Commendations; and therefore, ſhould I enlarge upon that Subject, I know I ſhould have but little Thanks for my Pains.

Indeed, You have much better Motives to do well, than the Praiſe of Men, the Favour of God, Peace of Conſcience, the Hope and Expectation of a future Reward of *Eternal Happineſs*; and, therefore, I had rather write of you to others, to provoke them to imitate ſo excellent an Example, than to Yourſelf, to encourage You in Your Chriſtian Courſe, and to fortify You in Your Athletick Conflicts with the greateſt of Temporal Evils, Bodily Pain and Anguiſh; tho' I do not know why You ſhould reject any Conſideration that may conduce to ſupport You under ſo heavy Preſſures, and of ſo long Continuance; of which, to ingenious Natures, true Honour, that is, the current Teſtimony and Approbation of good Men, is not the meaneſt. No leſs Man than St. *Auguſtin* was doubtful, whether the Extremity of Bodily Pain were not the greateſt Evil that Humane Nature was capable of ſuffering:

Nay (ſaith he) *I was ſometimes compelled to conſent to* Cornelius Celſus, *that it was ſo; neither did his Reaſons ſeem to me abſurd; we being compounded of two Parts, Soul and Body, of which, the firſt is the better, the latter the worſer. The greateſt Good muſt be the beſt Thing belonging to the better Part, that is, Wiſdom; and the greateſt Evil the worſt Thing incident to the worſer Part (the Body) that is, Pain.* Now, though I know not whether this Reaſon be firm and concluſive, yet I am of Accord with him, that of all the Evils we are ſenſible of in this World, it is the ſoreſt; the moſt reſolute Patience being baffled and proſtrated by a fierce and laſting Paroxyſm of the Gout, or Stone, or Cholick, and compelled to *yield to its furious Inſults*, and confeſs itſelf vanquiſhed, the Soul being unable to divert, or to do any thing elſe but pore upon the Pain. And, therefore, thoſe Stoical Vaunts of their wiſe Man's being happy in *Perillus*'s Bull, I utterly reject and explode, as vain Rhodomontades, and chimerical Figments; for that there never was ſuch a wiſe Man among them, or indeed could be: Yet do I not ſay, that the Patience of a good Man can be ſo far conquer'd by the ſharpeſt and ſevereſt Torments, as to be compelled to deny or blaſpheme *God*, or his *Religion*; yea, or ſo much as to complain of his Injuſtice, tho' perchance he may be brought with *Job* to curſe his Day, yet not curſe his God, as his Wife tempted him to do.

Now that the great Αγωνοθέτης, and Βραβευτής, the moſt juſt Judge and Rewarder, would be pleas'd ſo to qualify and mitigate your Sufferings, as not to exceed the *Meaſure of your Strength and Patience*, or elſe arm you with ſuch an high Degree of Chriſtian Fortitude, as to be able to grapple with the moſt Extreme; and when You have finiſh'd Your Courſe in this World, grant You a placid and eaſy Paſſage out of it, and dignify You as one of his Victors, with a Crown of Eternal Glory and Felicity, is the Prayer of,

MADAM,

Your LADYSHIP'S *moſt*

Devoted in all Service,

JOHN RAY.

THE

PREFACE.

IN *all Ages wherein Learning hath flouriſhed, Complaint hath been made of the Itch of Writing, and the Multitude of worthleſs Books, wherewith importunate Scriblers have peſter'd the World,* Scribimus indocti doctique: *And* ------- Tenet inſanabile multos Scribendi Cacoethes. *I am ſenſible that this Tractate may likely incur the Cenſure of a ſuperfluous Piece, and myſelf the Blame of giving the Reader unneceſſary Trouble, there having been ſo much ſo well written of this Subject, by the moſt learned Men of our Time,* Dr. Moore, *Dr.* Cudworth, *Dr.* Stillingfleet *late Biſhop of* Worceſter, *Dr.* Parker *late of* Oxon; *and, to name no more, the Honourable* Robert Boyle, *Eſq; ſo that it will need ſome Apology.* Firſt, *Therefore, in Excuſe of it, I plead, That there are in it ſome Conſiderations new and untouch'd by others: Wherein, if I be miſtaken, I alledge,* Secondly, *That the Manner of Delivery and Expreſſion may be more ſuit-*

able to ſome Mens Apprehenſion, and facile to their Underſtandings. If that will not hold, I pretend, Thirdly, *That all the Particulars contained in this Book, cannot be found in any one Piece known to me, but lie ſcattered and diſperſed in many; and ſo this may ſerve to relieve thoſe faſtidious Readers, that are not willing to take the Pains to ſearch them out: And poſſibly, there may be ſome whoſe Ability (whatever their Induſtry might be) will not ſerve them to purchaſe, nor their Opportunity to borrow, thoſe Books, who yet may ſpare Money enough to buy ſo inconſiderable a Trifle. If none of theſe Excuſes ſuffice to acquit me of Blame, and remove all Prejudice, I have two farther Reaſons to offer, which I think will reach home, and juſtify this Undertaking:* Firſt, *That all Men who preſume to write, at leaſt, whoſe Writings the Printers will venture to publiſh, are of ſome Note in the World; and where they do, or have lived and converſed, have ſome Sphere of Friends and Acquaintance, that know and eſteem them, who, it's likely, will buy any Book they ſhall write for the Author's Sake, who otherwiſe would have read none of that Subject, though ten times better; and ſo the Book, however inferiour to what have been already publiſhed, may happen to do much Good.* Secondly, *By Virtue of my Function, I ſuſpect myſelf to be obliged to write ſomething in Divinity, having written ſo much on other Subjects: For being not permitted to ſerve the Church with my Tongue in Preaching, I know not but it may be my Duty to ſerve it with my*

Hand by Writing: And I have made Choice of this Subject, as thinking myſelf beſt qualified to treat of it. If what I have now written ſhall find ſo favourable Acceptance, as to encourage me to proceed, God granting Life and Health, the Reader may expect more: If otherwiſe, I muſt be content to be laid aſide as uſeleſs, and ſatisfy myſelf in having made this Experiment.

As for this Diſcourſe, I have been careful to admit nothing for Matter of Fact, or Experiment, but what is undoubtedly true, leſt I ſhould build upon a ſandy and ruinous Foundation; and by the Admixture of what is falſe, render that which is true ſuſpicious.

I might have added many more Particulars; nay, my Text warrants me to run over all the viſible Works of God in particular, and to trace the Footſteps of His Wiſdom in the Compoſition, Order, Harmony, and Uſes of every one of them, as well as of thoſe that I have ſelected. But, Firſt, *this would be a Task far tranſcending my Skill and Abilities; nay, the joint Skill and Endeavours of all Men now living, or that ſhall live after a thouſand Ages, ſhould the World laſt ſo long.* For no Man can find out the Work that God maketh from the Beginning to the End, *Ecclеſ.* iii. 11. Secondly, *I was willing to conſult the Infirmity of the Reader, or indeed of Mankind in general; which, after a ſhort Confinement to one Sort of Diſh, is apt to loath it, though never ſo wholeſome, and which at firſt was moſt pleaſant and acceptable: And ſo to moderate my Diſcourſe, as to make an End of Wri-*

ting, before I might preſume he ſhould be quite tired with Reading.

I ſhall now add a Word or two concerning the Uſefulneſs of the Argument, or Matter of this Diſcourſe, and the Reaſon I had to make Choice of it, beſides what I have already offered.

First, *The Belief of a Deity being the Foundation of all Religion, (Religion being nothing but a devout Worſhiping of God, or an Inclination of Mind to ſerve and worſhip Him)* for he that cometh to God, muſt believe that he is God, *it is a Matter of the higheſt Concernment, to be firmly ſettled and eſtabliſhed in a full Perſuaſion of this main Point. Now this muſt be demonſtrated by Arguments drawn from the Light of Nature, and Works of the Creation: For as all other Sciences, ſo Divinity, proves not, but ſuppoſes its Subjects, taking it for granted, that by Natural Light, Men are ſufficiently convinced of the Being of a Deity. There are indeed ſupernatural Demonſtrations of this fundamental Truth, but not common to all Perſons, or Times, and ſo liable to Cavil and Exception by Atheiſtical Perſons, as inward Illuminations of Mind, a Spirit of Prophecy and Fore-telling future Contingents, illuſtrious Miracles, and the like. But theſe Proofs, taken from Effects and Operations, expoſed to every Man's View, not to be denied or queſtioned by any, are moſt effectual to convince all that deny, or doubt of it. Neither are they only convictive of the greateſt and ſubtleſt Adverſaries, but intelligible alſo to the meaneſt Capacities: For you may hear illite-*

vate Perſons of the loweſt Rank of the Commonalty, affirming, That they need no Proof of the Being of a God, for that every Pile of Graſs, or Ear of Corn, ſufficiently proves that: For, ſay they, all the Men of the World cannot make ſuch a Thing as one of theſe; and if they cannot do it, who can, or did make it but God? To tell them, that it made itſelf, or ſprung up by Chance, would be as ridiculous as to tell the greateſt Philoſopher ſo.

Secondly, *The Particulars of this Diſcourſe ſerve not only to demonſtrate the Being of a Deity, but alſo to illuſtrate ſome of his principal Attributes; as namely, his infinite Power and Wiſdom. The vaſt Multitude of Creatures, and thoſe not only ſmall, but immenſly great, the Sun and Moon, and all the Heavenly Hoſt, are Effects and Proofs of His Almighty Power.* The Heavens declare the Glory of God, and the Firmament ſheweth His Handy-Work, *Pſal.* xix. 1. *The admirable Contrivance of all and each of them, the Adapting all the Parts of Animals to their ſeveral Uſes, the Proviſion that is made for their Suſtenance, which is often taken Notice of in Scripture,* Pſal. cxlv. 15, 16. The Eyes of all wait upon Thee: Thou giveſt them their Meat in due Seaſon. Thou openeſt Thy Hand, and ſatisfieſt the Deſire of every living Thing. *Matth.* vi. 26. Behold the Fowls of the Air, for they ſow not, neither do they reap, nor gather into Barns; yet your Heavenly Father feedeth them. *Pſal.* cxlvii. 9. He giveth to the Beaſt his Food, and to the young Ravens when they cry. *And,* Laſtly, *Their mutual Subſerviency to each other, and unanimous conſpiring to promote and carry on the*

Publick Good, are evident Demonſtrations of His Sovereign Wiſdom.

Laſtly, *They ſerve to ſtir up and increaſe in us the Affections and Habits of Admiration, Humility, and Gratitude. Pſal.* viii. 3. When I conſider'd the Heavens, the Work of Thy Fingers, the Moon and the Stars which Thou haſt ordained: What is Man that Thou art mindful of him, or the Son of Man that Thou viſiteſt him? *And to theſe Purpoſes the Holy Pſalmiſt is very frequent in the Enumeration and Conſideration of theſe Works, which may warrant me doing the like, and juſtify the denominating ſuch a Diſcourſe as this, rather Theological than Philoſophical.*

[*Note*, That by the Works of the Creation, in the Title, I mean the Works created by God at firſt, and by Him conſerv'd to this Day in the ſame State and Condition in which they were at firſt made; for *Conſervation* (according to the *Judgment both of Philoſophers and Divines*) is *a continued Creation.*]

THE CONTENTS OF THE FIRST PART.

THE Multitude of Creatures an Argument of the Wiſdom and Power of God, Page 18 *and* 26
That the fix'd Stars are innumerable, agreed on all Sides, as well by ſuch as embrace the New Hypotheſis,
That they are as ſo many Suns placed at unequal Diſtances, and each having its Planets moving about it, furniſhed with their Inhabitants, like the Earth; as by thoſe that adhere to the old, That they are all ſituate in the ſame ſpherical Superficies 18, 19, 20
A Gueſs at the Number of Terreſtrial Bodies, 1. *Inanimate, as Stones, Earths, concrete and inconcrete Juices, Metals, and Minerals.* 2. *Animals, Birds, Beaſts, Fiſhes, and Inſects.* 3. *Plants, Herbs, and Trees* 21, 22, 23, 24
Working the ſame Effect by divers Means and Inſtruments, an Argument of Wiſdom; and that God doth this in the Works of the Creation, proved by ſeveral Examples 25, 26, 27, 28
That the material Works of God are wiſely contrived and adapted to Ends both general and particular 29, 30
The Ariſtotelean Hypotheſis, *That the World was Co-eternal with God condemned* 30, 31

The Epicurean Hypotheſis, *That the World was made by a caſual Concurrence, and Coheſion of Atoms, rejected* 31, 32, 33. *Their Declination of Atoms juſtly derided, and their whole* Hypotheſis *ingeniouſly confuted by* Cicero Page 34, 35, 36, 37

The Carteſian Hypotheſis, *That ſuppoſing God had only created Matter, divided it into a certain Number of Parts, and put it into Motion, according to a few Laws, it would of itſelf have produced the World without any more ado, confuted in* Dr. Cudworth's *Words* 37, &c. *to* 46

Des Cartes *his Aſſertion, That the Ends of God in any of his Works are equally undiſcover'd by us, cenſured and reproved* 38, 39, 40, 41

His Opinion concerning the Cauſe of the Motion of the Heart 45, 46, 47

The Honourable Mr. Boyle's Hypotheſis *conſidered, and pleaded againſt* 48, 49, 50

The Author's Miſtake concerning the Hypotheſis *of Mr.* Boyle, *acknowledged* 50

The Parts of the Body formed, and ſituated contrary to the Laws of the Specifick Gravity 51

A Plaſtick Nature under God, ſuperintending and effecting natural Productions 52, 53

Their Opinion that hold the Souls of Brutes to be material, and the whole Animal Body and Soul to be a mere Machine, not agreable to the general Senſe of Mankind 54, 55, 56

Of the viſible Works of God, and their Diviſion 57, 58. *The* Atomick Hypotheſis *approved* 59

The Works of Nature far more exquiſitively formed than the Works of Art 59, 60

The various Species of inanimate Bodies to be attributed to the divers Figures of their Principles, or minute component Particles 60. *That theſe Principles are naturally indiviſible proved,* ibid. *They are not very numerous* 61

Of the heavenly Bodies, 61. *That the whole Univerſe is divided into two Sorts of Bodies,* viz. *thin and fluid, denſe and conſiſtent,* ibid. *That this laſt Sort are endued with a twofold Power;* 1. *Of Gravity.* 2. *Of Circular Motion, and why,* 62. *The heavenly Bodies moved in the moſt regular, facile, and convenient Manner* 63, 64

Of the Sun, *his Uſes, and the Convenience of his Situation and Motion* 65

Of the Moon, *and its Uſes* 66

Of the reſt of the Planets, and Fix'd Stars; the Regularity and Conſtancy of their Motions; whence Cicero *rationally infers, that they are governed by Reaſon* 67

Eclipſes uſeful to ſettle Chronology, and determine Longitudes Page 68

Of terreſtrial inanimate ſimple Bodies, as Elements, *commonly ſo called*; 1. Fire, *its various Uſes* 69, 70. *Of Air, its Uſe and Neceſſity for Breathing, to all Sorts of Animals, Aquatick as well as Terreſtrial; nay, in a Sort, to Plants themſelves* 71, 72, 73. *The Effects and Uſes of its Gravity and Elaſtick Quality* 72, 73

That the Fœtus *in the Womb hath a Kind of Reſpiration, and whence it receives the Air* 73, 74, 75

That the Air inſinuates itſelf into the Water for the Reſpiration of Fiſhes 76, *and even into ſubterraneous Waters, whence it clears the Mines of Damps* 76, 77. *A Plaſtick Nature neceſſary for putting the Diaphragm and Muſcles for Riſpiration into Motion at firſt* 77

Of Water, *its Uſes* 78. *Of the Sea, and its Tides* 79. *An Objection concerning the Needleſneſs of ſo much Sea, of no Uſe to Mankind, anſwered. And the Wiſdom of God in thus unequally dividing Sea and Land, manifeſted and aſſerted* 80, 81. *The Uſe of Floods* 82, 83

That the Winds bring up more Vapours from the Sea, than they carry down thither 84, 85

That the Motion of the Water levels the Bottom of the Sea 85. *The Reaſon why the Sea-Plants grow, for the moſt Part, flat, like a Fan, and none in the Great Depths* 86

Of Springs and Rivers, Baths and Mineral Waters. Simple Water nouriſheth not 87

Of the Earth, *its Uſes and Differences* ibid.

Of Meteors, *or Bodies imperfectly mix'd. And,* 1. *Of Rain* 88. 2. *Of Wind, and its various Uſes* 90

Of inanimate mix'd Bodies; 1. Stones, *their Qualities and Uſes* 91, 92, 93. *Particularly of the* Loadſtone, *its admirable Phænomena, Effects, and Uſes* 95. 2. Metals, *their various Uſes, of great Importance to Mankind, as* Iron, *without which we could have had nothing of Culture, or Civility: Gold and Silver for the Coining of Money, which how many Ways uſeful is ſhewn out of* Dr. Cockburn's *Eſſays* 96, 97

That the minute compotent Particles of Bodies are naturally indiviſible, proved 98, 99

Of Vegetables, *or* Plants, *their Stature and Magnitude, Figure, Shape, and Site of Leaves, Flowers, and Fruits, and their Parts all determined, as alſo their Age and Duration* 100, 101 *The admirable Complication of the Seminal Plants* 101, 102 *The Uſes of the ſeveral Parts of Plants, Roots, Fibres, Veſſels,*

Barks, and Leaves 103, 104. *The Beauty and Elegancy of the Leaves, Flowers, and Fruits of Plants* 105. *That there is ſuch a Thing as Beauty and Comelineſs of Proportion, proved* Page 106
The Uſes of Flowers 107. *Of Seeds, and their Teguments, and Obſervations concerning them* 108, 109. *Their laſting Vitality, or Fœcundity* 110. *The Pappous Plumage of Seeds* 110. *The Tendrels and Prickles of Plants, of what Uſe* 111
That Wheat, the beſt of all Grains, is patient both of Heat and Cold, and ſcarce refuſeth any Climate, and that ſcarce any Grain is more fruitful 112
Of the Signatures of Plants 113
Of Animals, *the Proviſion that is made for the Continuance of Species* 114. *That Females have within them from the Beginning, the Seeds of all the Young they ſhall ever bring forth* 115. *An Obſervation of* Cicero's *about Multiparous Creatures* 116. *Why Birds lay Eggs*, ibid. *Of what Uſe the Yolk of the Egg is to the Chicken* 117
Birds that cannot number, yet omit not any one of their Young in feeding of them 117. *Though they cannot number, yet that they can diſtinguiſh many from few, proved* 118. *The ſpeedy Growth of the young Birds in the Neſt* 119. *The Proceſs of building their Neſts, and Incubation* 120. *Feeding, breeding, and dedefending their Young, and the admirable* Στοργή, ibid. *The due numerical Proportion between Males and Females, in all Kinds of Animals, kept up conſtantly* 121. *The Conveniency of the Time of the Year, when the ſeveral Sorts of Animals are brought forth* 122. *Why Birds ſwallow Pebble-Stones* 130. *The Proviſion of Nature for keeping of Birds-Neſts clean* 132, 133. *Various ſtrange Inſects of Animals* 125, 126, 127, &c. *As, that Animals ſhould know where their natural Weapons are ſituate, and how to make uſe of them. That the Weak and Timorous ſhould be made ſwift of Foot or Wing, for Flight. That they ſhould naturally know their Enemies, and ſuch as prey upon them, though they had never ſeen them before. That as ſoon as they are brought forth, they ſhould know their proper Food. That Ducklings, though led by a Hen, ſo ſoon as they ſee Water, ſhould venture into it, the Hen in vain endeavouring to hinder or reclaim them. That Birds of the ſame Kind ſhould make Neſts exactly alike, whereſoever bred, and though they had never ſeen a Neſt made.*
The Migration of Birds from one Country to another, a ſtrange and unaccountable [illegible]on 128

The wonderful Art obſervable in the Conſtruction, Situation, and Figure of the Cells in Honey-combs 132, 133, 134. *That Bees and other Animals, lay up in ſtore, either for the Food of their Young, or their own Winter Proviſion,* Page 135

The Proviſion that is made for the Preſervation and Security of weak and timorous Creatures, and for the diminiſhing of the rapacious 136, 137, 138

The Fitneſs of the Parts of the Bodies of Animals to every one's Nature and Manner of Living, inſtanced in, 1. *The Swine,* 139, &c. 2. *The Mole,* 141. 3. *The* Tamandua *or Ant-Bear,* 142. 4. *The* Chamælion, 143. 5. *The whole Genus of* Wood-Peckers, ibid. 6. Swallows, 144. 7. Doukers *or* Loons 145

In Birds all the Members are fitted for the Uſe of flying 146, &c. *The Uſe of the Tail in Birds* 147

The Bodies of Fiſhes moſt conveniently formed and provided for the Uſe of Swimming 150, 151. *And particularly thoſe of Cetaceous Fiſhes for the Reſpiration, and preſerving their Natural Heat* 151, 152. *And of Amphibious Creatures* ibid.

The fitting of the Parts of Animals one to another, viz. *The Genitals of the Sexes* 153. *The Nipples of the Paps to the Mouth and Organs of Suction* ibid. *The admirable Structure of the Breaſts or Paps, for the preparing and ſeparating, the containing and retaining of the Milk, that it doth not flow out without Preſſure or Suction* 154

Several Obſervations of Ariſtotle'*s, relating to the Fitneſs of the Parts to the Creatures Nature and Manner of Living, and to their reſpective Uſes* 155, 156

Another remarkable Inſtance in proportioning the Length of the Necks to that of Legs in Animals 157, 158. *Of the* Aponeuroſis *in the Neck, why given to moſt Quadrupeds, and not to Man* 157. *That ſome Birds have but ſhort Legs, and yet long Necks, and why* 158. *That this Inſtance cannot be accounted for by Atheiſts* ibid.

The various Kinds of Voices the ſame Animal uſes on divers Occaſions, and to divers Purpoſes, argumentative of Providence and Council, in conferring them upon it, being ſo extreamly uſeful and ſerviceable to the Creature 159

An Objection againſt the Uſe of ſeveral Bodies I have inſtanced in, relating to Man anſwered 160. *A Diſcourſe in the Perſon of Almighty God to Man* 161, 162, &c.

The incredible Smallneſs and Subtleneſs of ſome Animalcules, an Argument and Proof of the admirable Art of the Creator 166, 167

Practical Inferences from the precedent Diſcourſe, wherein it is ſhewn, That the World was in ſome Senſe made for Man, yet not ſo as to have no other End or Uſe of its Creation, but to ſerve him 169, 170, &c. *The Contemplation and Conſideration of the Works of God, may probably be ſome Part of our Employment in Heaven* Page 171, 172

The Sun, Moon, Stars, &c. *are called upon to praiſe God, which they can do no otherwiſe, than by affording Man, and other intelligent Beings, Matter or Subject of praiſing him. And therefore Men and Angels are called upon to conſider thoſe Great Effects of the Divine Power, Wiſdom and Goodneſs, and to give God the Praiſe and Glory due to him for them,* 178, 179, 180, &c. *That God doth, and may juſtly intend and deſign his own Glory* 182, 183, 184, 185

THE
CONTENTS
OF THE
SECOND PART.

I. O*F the whole Body of the Earth: And firſt, of its* Figure, *which is demonſtrated to be Spherical* Page 190, 191

The Conveniences of this Figure ſhewn for Union of Parts, Strength, Convenience of Habitation, and Circular Motion, upon its own Poles 191, 192, 193

II. *Of its Motion, both diurnal upon its own* Poles, *and annual in the Ecliptick; and both theſe ſhewn to be rational and not diſſonant to Scripture* 193, 194, &c. *The preſent Direction and conſtant Paralleliſm of its Axis to itſelf, ſhewn to be moſt convenient for the Inhabitants of the Earth, by the Inconvenience of any different Poſition* 196, 197, 198, &c. *That the Torrid Zone is habitable, and ſtored with great Multitudes of Men, and other Animals, contrary to the Opinion of ſome of the Ancients* 200. *Neither are the Heats there prejudicial to the Longævity of Men,* ibid. *A Digreſſion to prove, that the Lives of Men are longeſt in the hotteſt Countries* 201, 202. *That it would not be more convenient for the Inhabitants of the Earth, if the Tropicks ſtood at a greater Diſtance, proved* 204, 205. *A very conſiderable and heretofore unobſerv'd Convenience of this Inclination of the Earth's* Axis, *which Mr.* Keill *affords us* 203, 204

Of the Uſefulneſs of the preſent Figure, Conſtitution, and Conſiſtency of the ſeveral Parts of this Tarraqueous Globe 205, 206, 207

An Enumeration of ſome Plants, which afford almoſt whatever is neceſſary for Human Life 208, 209, 210, &c.

Plants having a Kind of Ciſterns, or Baſins, formed of their Leaves compacted together, for the containing and preſerving of Water

during

Of Mountains, and their Uſes Page 215 to 220.

II. *The Wiſdom of God diſcovered in the Structure of the Bodies of Man, and other Animals.*

Eleven general Obſervations, demonſtrating this Wiſdom and Goodneſs of God in forming our Bodies;

1. *The erect Poſture of the Body of Man* 221. *commodious,* [1.] *For the ſuſtaining of the Head* 222. [2.] *For Proſpect,* ibid. [3.] *For walking and uſing our Hands* 223, 224. *That this Erection of the Body was intended by Nature, proved by ſeveral Arguments, and particularly by the faſtening the Cone of the Heart to the Midriff, of which an Account is given out of Dr.* Tyſon's *Anatomy of the* Ourang Outang 225, 226
2. *In that there is nothing deficient or redundant in the Body of Man* 227. *A notable Story of a Man's giving Suck to a young Child, well atteſted* ibid.
3. *The Parts of the Body moſt conveniently ſituate, for Uſe, for Ornament, and for mutual Aſſiſtance* 229, 230
4. *Ample Proviſion made for the Defence and Security of the principal Parts, Heart, Brain, and Lungs* 231, 232, 233
5. *Abundant Proviſion made againſt evil Accidents and Inconveniences* 234, 235

Some Obſervations concerning Sleep 235, 236

That the Unſenſibleneſs of Pain during Sleep, proceeds rather from the Relaxation of the Nerves than their Obſtruction 237

6. *The Conſtancy obſerved in the Number, Figure, and Site of the principal Parts, and the Variety in the leſs* 238
7. *The annexing of Pleaſure to thoſe Actions that are neceſſary for the Support of the* Individuum, *and the Continuation and Propagation of the Kind* 239
8. *The Multitude of Intentions the Creator muſt have in the Formation and Fitting the ſeveral Parts for their reſpective Actions and Uſes* 240, 241
9. *The fitting and accommodating ſome Parts to divers Offices and Uſes, an Argument of Wiſdom and Deſign in the Contrivance of the Body of Man, and other Animals* 241, 242
10. *In the Nouriſhment of their Bodies, making that Food which is proper to preſerve them in a healthful State, grateful to the Taſte, and agreable to the Stomach. Of the great Uſe of Pain* 243, 244
11. *The Variety of Lineaments and Diſſimilitude of the Faces of Men, as alſo of their Voices, and Hand-writings, all of mighty Importance to Man* 245, 246, 247

Of the particular Parts of the Body: And, 1. *Of the Head and Hair* 248. *The Reaſon of Baldneſs.* 2. *Of the Eye: Its Beauty* 249. *Its Humours and Tunicles tranſparent* 250, &c. [1.] *For the Clearneſs.* [2.] *For the Diſtinctneſs of Viſion*, ibid. *The Parts of the Eye of a Figure moſt convenient for the Collection of the viſual Rays*, viz. *Convex* 252. *The Uveous Tunicle hath a Muſculous Power for contracting and dilating of the Pupil*, ibid. *Its Inſide, and that of the* Choroids, *why blackned* 253. *The Figure of the Eye alterable, according to the Exigency of the Object, in Reſpect of Diſtance, or Propinquity* 254, 255. *Why the Optick Nerve is not inſerted right behind the Eye* ibid. *Why, though the Rays be decuſſated in the Pupil of the Eye, the Object is not ſeen inverted* 255. *The Uſe of the Aqueous Humour, and that it is ſuddenly reparable* 256. *The* Tunica Cornea *protuberant above the White of the Eye, and why* 257. *The Uſe of the Muſcles of the Eye* ibid. *The Proviſion for the Defence and Security of this precious Part* 258. *The Uſes of the Eye-lids, and their frequent winking* 259. *That as Man wants, ſo he needs not the ſeventh or ſuſpenſory Muſcle, which is of great Uſe and Neceſſity to Brutes* 261. *The Need and Uſe of the nictating Membrane in Brutes, and that Man needs it not* Page ibid.

Thirdly, *Of the* Ear 262. *The Uſe of the* Auricula 263. *Of the* Tympanum *of the Ear, its Bones, and their Muſcles, and of the Uſe of the* Ear-Wax, *&c.* 264

Fourthly, *Of the* Teeth, *nine remarkable Obſervations concerning their Situation, Structure, and Uſes* 264, 265, 266, &c.

Fifthly, *Of the* Tongue, *and its various Uſes, for taſting and gathering of Food, for managing of Maſtication, for forming of Words,* &c. 268. *Speaking proper to Man* ibid. *Of the* Ductus Salivales, *and of the great Uſe of the* Saliva *or Spittle* 269

Sixthly, *Of the* Wind-Pipe, *its admirable Structure and Uſes* 270

Seventhly, *Of the Heart, the Uſe and Neceſſity of its Pulſe for the Circulation of the Blood, and the admirable Make and Contrivance of it for that Office* 271, 272, &c. *Of the Muſcular Coat, and Pulſe of the Arteries, effected by a Kind of Conſtriction, or Periſtaltick Motion, and not merely by a Wave of the Blood every Pulſe* 273, 274, &c.

The wonderful Artifice of Nature in regulating the Motion of the Blood in the Veins and Arteries, by aſſiſting and promoting it in the one, and moderating it in the other. The Uſe of the Vena ſine pari 277

Eighthly, *Of the* Hand, *its Structure and various Uſes, not eaſily to be enumerated* 278, 279

Ninthly, *Of the* Back-Bone, *its Figure, and why divided into Vertebres* Page 282, 283
The Proviſion that is made for the eaſie and expedite Motion of the Bones in their Articulation by a two-fold Juice. 1. *An* Oily *one ſupplied by the Marrow.* 2. *Mucilaginous prepared and ſeparated by certain Glandules made for that Purpoſe* 284, 285. *This Inunction of the Head of the Bones, with theſe Juices, is uſeful,* 1. *To facilitate Motion.* 2. *To prevent Attrition* 286
Why the Bones are made hollow 287
Why the Belly is fleſhy, and not incloſed with Bones like the Breaſt 288
The Motion of the Guts 289. *Of the Liver, and Uſe of the Gall,* ibid.
Of the Bladder, its Structure and Uſe, of the Kidneys and Glandules, and Ureters, their Compoſition and Uſes ibid.
The adapting all the Bones, Muſcles, and Veſſels, to their ſeveral Uſes, and the joining and compacting of them together noted 290
The Geometrical Contrivance of the Muſcles, and fitting them for their ſeveral Motions and Actions, according to the exacteſt Rules of Mechanicks ibid.
The packing and thruſting together ſuch a Multitude of various and different Parts ſo cloſe, that there ſhould be no unneceſſary Vacuity in the Body, nor any claſhing between them, but mutual Aſſiſtance, admirable ibid.
Membranes capable of a prodigious Extention, Uſe in Geſtation of Twins, &c. 291
The Parts that ſeem of little or no Uſe, as the Fat, *ſhewn to be greatly uſeful* 292. *How ſeparated from the Blood, and received into it again* 293, 294
The Conſideration of the Formation of the Fœtus *in the Womb waved, and why* 295, 296
What a Fitneſs the Seed hath to Faſhion and Form, and why the Child reſembles the Parent, and ſometimes the Anceſtor 296
The Conſtruction of a Set of Temporary Parts, for the Uſe of the Fœtus *only while in the Womb, a clear Proof of Deſign* 297
No equivocal or ſpontaneous Generation, but that all Animals are generated by Animal-Parents of their own Kind 298, 299. *And probably all Plants too produced by Seed, and none ſpontaneous, proved and vindicated, and the Objections againſt it anſwered* 300 to 307
That the Coſſus *of the Ancients was not the* Hexapod *of a* Beetle, *as I thought, but an* Eruca, *agreed with Dr.* Liſter 307
The Louſe ſearching out ſordid and naſty Clothes to harbour and breed in, probably deſigned to deter Men and Women from Sluttiſhneſs and Uncleanlineſs 308

An

An additional and moſt effectual Argument againſt ſpontaneous Generation; viz. *That there are no new Species of Animals produced* Page 308, 309

Whence thoſe vaſt Numbers of ſmall Frogs, which have been obſerved to appear upon refreſhing Showers, after Drought, do probably proceed, ſhewn in an Inſtance of his own Obſervations by Mr. Derham. 316, 317

Of Toads found in the Heart of Timber-Trees, and in the Middle of great Stones 323, 324

Miſcellaneous Obſervations concerning the Structure, Actions, and Uſes of ſome Parts of Animals omitted in the firſt Part. As alſo the Reaſons of ſome Inſtincts and Actions of Brutes 325, 326, &c. *The Swines Snout fitted for digging up of Roots, which are his Natural Food, as likewiſe the Porpeſſe for rooting up of Sand-Eels.*

The Manner and Organs of Reſpiration accommodate to the Temper of Animals, their Place and Manner of Living ſhewn in three Sorts of Reſpiration. 1. *By Lungs, with two Ventricles of the Heart in hotter Animals* 327. 2. *By Lungs, with but one Ventricle.* 3. *By Gills, with one only Ventricle of the Heart* 329, &c. *Why the* Foramen Ovale *is kept open in ſome Amphibious Animals* 330. *In ſome of them the* Epiglottis *is large, and why* 331. *No* Epiglottis *in Elephants, and why; and how that Creature ſecures himſelf from Mice creeping up his* Proboſcis *into his Lungs* 332

Two notable Obſervations of the Sagacity of the Tortoiſe, *the one of the Land, the other of the Sea*-Tortoiſe 333, 334

The Armour of the Hedge-Hog, *and* Taton, *and their Power of contracting themſelves into a round Ball, a great Inſtance of Deſign for their Defence and Security* 335, 336

The Manner and Uſe of the extending and withdrawing the Curtain of the Periophthalmium, *or nictating Membrane in Beaſts and Birds* 338, 339. *That the Aqueous Humour of the Eye will not freeze* 343

Of the Make of a Camel's Foot, and his Bags to reſerve Water in his Stomach for his Needs 344, 345

The Uſe of rapacious Creatures ſwallowing ſome of the Hair, Furr, and Feathers, of the Beaſts, or Birds, they prey upon 344, 345

A Conjecture by what Means Cartilaginous Fiſhes raiſe and ſink themſelves in the Water 346

That Nature employs all the Methods and Artifices of Chymiſts, in analyzing of Bodies, and ſeparating their Parts, and outdoes them, and the ſeveral Particulars inſtanced in 347

Obſervations about the Gullet and Diaphragm 348

An admirable Story out of Galen, *about the taking a Kid out of the Womb of its Dam, and bringing it up by Hand, and Remarks upon it* Page 349, 353

The natural Texture of Membranes ſo made, as to be immenſly dilatable, of great Uſe and Neceſſity in Geſtation 353

A notable Inſtance of Providence, in the Make of the Veins and Arteries near the Heart 354, 355

An Anſwer to an Objection againſt the Wiſdom of God, in making inferior Ranks of Creatures 357

The Atheiſts main Subterfuge and Pretence, to elude and evade all our Arguments and Inſtances, to demonſtrate the Neceſſity of Providence, Deſign, and Wiſdom, in the Formation of all the Parts of the World, viz. That Things made Uſes, and not Uſes Things, *precluded and confuted* 357, 358

Of the Uſe of thoſe vaſt Numbers of prodigiouſly ſmall Inſects that are bred in the Waters 363, 364

An Objection againſt the Wiſdom of God, in creating ſuch a Multitude of uſeleſs Inſects, and ſome alſo noxious and pernicious to Man, and other Animals, anſwered, and the various Uſe of them declared 368, 369, &c.

Many Practical Inferences and Obſervations, from 375 to the End of the Book.

THE WISDOM of GOD Manifeſted in the WORKS OF THE CREATION.

PART I.

PSAL. civ. 24.

How manifold are thy Works, O Lord! In Wiſdom haſt thou made them all.

IN theſe Words are two Clauſes; in the firſt whereof the Pſalmiſt admires the Multitude of God's Works, *How manifold are thy Works, O Lord!* In the ſecond he celebrates his Wiſdom in the Creation of them; *In Wiſdom haſt thou made them all.*

Of the firſt of theſe I ſhall ſay little, only briefly run over the Works of this viſible World, and give ſome Gueſs at the Number of them; whence it will appear, That upon this account they will deſerve Admiration, the Number of them being uninveſtigable by us, and ſo affording us a demonſtrative Proof of the unlimited Extent of the Creator's Skill, and the Fœcundity of his Wiſdom and Power. That the Number of corporeal Creatures is unmeaſurably great, and known only to the Creator himſelf, may thus probably be collected: Firſt of all, The Numbers of fixed Stars is on all Hands acknowledg'd to be next to infinite: Secondly, Every fix'd Star, in the now-receiv'd *Hypotheſis*, is a Sun, or Sun-like Body, and in like Manner incircled with a *Chorus* of Planets moving about it; for the *fix'd Stars* are not all placed in one and the ſame concave Spherical *Superficies*, and equidiſtant from us, as they ſeem to be, but are variouſly and diſorderly ſituate, ſome nearer, ſome further off, juſt like Trees in a Wood or Foreſt, as *Gaſſendus* exemplifies them. And as in a Wood, tho' the Trees grow never ſo irregularly, yet the Eye of the Spectator, wherever plac'd, or whitherſoever remov'd, deſcribes ſtill a Circle of Trees: So would it in like manner wherever it were in the Foreſt or Stars, deſcribe a Spherical *Superficies* about it. Thirdly, Each of theſe Planets is in all likelihood furniſhed with as great Variety of corporeal Creatures, animate and inanimate, as the Earth is, and all as different in Nature as they are in Place from the Terreſtrial, and from each other. Wence it will follow, That theſe muſt be much more infinite than the Stars; I do not mean abſolutely according to Philoſophick Exactneſs infinite, but only infinite or innumerable as to us, or their Number prodigiouſly great.

That the fix'd Stars are innumerable, may thus be made out: Thoſe viſible to the naked Eye are by the leaſt Account acknowledg'd to be above a Thouſand, excluding thoſe towards the *South* Pole, which are not viſible in our Horizon: Beſides theſe, there have been incomparably more detected and brought to Light by the Teleſcope; the Milky-way being found to be (as was formerly conjectur'd) nothing but great Companies or Swarms of Minute Stars ſingly inviſible, but by reaſon of their Proximity mingling and confounding their Lights, and appearing like lucid Clouds. And it is likely that, had we more perfect Teleſcopes, many Thouſands more might be diſcovered; and yet, after all, an incredible Multitude remain, by reaſon of their immenſe Diſtance beyond all Ken, by the beſt Teleſcopes that could poſſibly be invented or poliſh'd by the Wit and Hand of an Angel: For if the World be (as *Des Cartes* would have it) indefinitely extended, that is, ſo far as no humane Intellect can fancy any Bounds of it; then what we ſee, or can come to ſee, muſt be the leaſt Part of what is undiſcoverable by us, the whole Univerſe extending a thouſand Times farther beyond the utmoſt Stars we can poſſibly deſcry, than thoſe be diſtant from the Earth we live upon. This *Hypotheſis* of the *fix'd Stars* being ſo many *Suns*, *&c.* ſeems more agreable to the Divine Greatneſs and Magnificence. But that which induces me much to doubt of the Magnitude of the Univerſe, and immenſe Diſtance of the *fix'd Stars*, is the ſtupendous *Phænomena* of *Comets*, their ſudden Accenſion, or Appearance in full Magnitude, the Length of their Tails, and Swiftneſs of their Motion, and gradual Diminution of Bulk and Motion, 'till at laſt they diſappear. That the Univerſe is indefinitely extended, *des Cartes*, upon a falſe Ground, [that the *formal Ratio* of a Body was nothing but Extenſion into Length, Breadth and Profundity, or having *partes extra partes*, and that *Body* and *Space* were ſynonymous Terms] aſſerted; it may as well be limited this Way, as in the old *Hypotheſis*, which places the *fix'd Stars* in the ſame Spherical *Superficies*; according to which (old *Hypotheſis*) they may alſo be demonſtrated by the ſame *Mediums* to be innumerable, only inſtead of their Diſtance ſubſtituting their Smalneſs for the Reaſon of their Inviſibility.

But leaving the *Cœleſtial* Bodies, I come now to the *Terreſtrial*; which are either *inanimate*, or *animate*. The *inanimate* are the *Elements*, *Meteors*, and *Foſſils* of all Sorts, at the Number of which laſt I cannot give any probable Gueſs: But if the Rule, which ſome conſiderate Philoſophers deliver, holds good, *viz.*

how much more imperfect any *Genus*, or Order of Beings is, ſo much more numerous are the *Species* contain'd under it. As for Example: Birds being a more perfect Kind of Animals than Fiſhes, there are more of theſe than of thoſe; and for the like Reaſon more Birds than Quadrupeds, and more Inſects than of any of the Reſt, and ſo more Plants than Animals, Nature being more ſparing in her more excellent Productions. If this Rule, I ſay, holds good, then ſhould there be more *Species* of *Foſſils*, or generally of *inanimate Bodies*, than of *Vegetables*, of which there is ſome Reaſon to doubt, unleſs we will admit all Sorts of formed Stones to be diſtinct *Species*.

Animate Bodies are divided into Four great *Genera*, or Orders, *Beaſts*, *Birds*, *Fiſhes*, and *Inſects*.

The *Species* of *Beaſts*, including alſo *Serpents*, are not very numerous: Of ſuch as are certainly known and deſcrib'd, I dare ſay not above 150; and yet I believe, not many, that are of any conſiderable Bigneſs, in the known Regions of the World, have eſcap'd the Cognizance of the Curious. [I reckon all *Dogs* to be of one *Species*, they mingling together in Generation, and the Breed of ſuch Mixtures being prolifick.]

The Number of *Birds* known and deſcrib'd may be near 500; and the Number of *Fiſhes*, ſecluding *Shell-Fiſh*, as many: But if the *Shell-Fiſh* be taken in, more than ſix times the Number. How many of each *Genus* remain yet undiſcover'd, one cannot certainly nor very nearly conjecture; but we may ſuppoſe the whole Sum of *Beaſts* and *Birds* to exceed by a third Part, and *Fiſhes* by one half, thoſe known.

The *Inſects*, if we take in the *Exanguious* both *Terreſtrial* and *Aquatick*, may, in Derogation to the precedent Rule, for Number, vie even with *Plants* themſelves: For the *Exanguious* alone, by what that Learned and Critical Naturaliſt, my honour'd Friend, Dr. *Martin Liſter*, hath already obſerv'd and delineated, I conjecture, cannot be fewer than 3000 *Species*, perhaps many more.

The *Butterflies* and *Beetles* are ſuch numerous Tribes, that I believe in our own native Country alone the *Species* of each Kind may amount to 150 or more. And if we ſhould make the *Caterpillers* and *Hexapods*, from whence theſe come, to be diſtinct *Species*, as moſt Naturaliſts have done, the Number will be doubled, and theſe two *Genera* will afford us 600 *Species*: But if thoſe be admitted for diſtinct *Species*, I ſee no Reaſon but their *Aureliæ* alſo may pretend to a ſpecifick Difference from the *Caterpillers* and *Butterflies*, and ſo we ſhall have 300 *Species* more; therefore we exclude both theſe from the Degree of *Species*, making them to be the ſame *Inſect* under a different *Larva* or Habit.

The *Fly-kind*, if under that Name we comprehend all other flying *Inſects*, as well ſuch as have four, as ſuch as have but two Wings, of both which Kinds there are many ſubordinate *Genera*, will be found in Multitude of *Species* to equal, if not exceed, both the forementíon'd Kinds.

The *creeping Inſects* that never come to be wing'd, tho' for Number they may fall ſhort of the flying or winged, yet are they alſo very numerous; as by running over the ſeveral Kinds I could eaſily demonſtrate. Suppoſing then there be a Thouſand ſeveral Sorts of Inſects in this Iſland and the Sea near it, if the ſame Proportion holds between the Inſects native of *England*, and thoſe of the reſt of the World, as doth between Plants *domeſtick* and *exotick*, (that is, as I gueſs, near a Decuple) the Species of *Inſects* in the whole Earth (Land and Water) will amount to 10000, and I do believe they rather exceed than fall ſhort of that Sum. Since the Writing hereof, having this Summer, *Ann.* 1691. with ſome Diligence proſecuted the Hiſtory of our *Engliſh* Inſects, and making Collections of the ſeveral Species of each Tribe, but particularly and eſpecially of the *Butterflies*, both nocturnal and diurnal, I find the Number of ſuch of theſe alone as breed in our Neighbourhood [about *Braintree* and *Notely* in *Eſſex*] to exceed the Sum I laſt Year aſſign'd to all *England*, having my ſelf obſerv'd and deſcrib'd about 200 Kinds great and ſmall, many yet remaining, as I have good Reaſon to believe, by me undiſcover'd. This I have, ſince the writing hereof, found true in Experience, having every Year obſerv'd not a few new Kinds: Nor do I think that, if I ſhould live 20 Years longer, I ſhould by my utmoſt Diligence and Induſtry in ſearching them out, come to an End of them. If then, within the ſmall Compaſs of a Mile or two, there are ſo many Species to be found, ſurely the moſt modeſt Conjecture cannot eſtimate the Number of all the Kinds of *Papilio's* native of this Iſland to fall ſhort of 300, which is twice ſo many as I laſt Summer gueſs'd them to be; wherefore, uſing the ſame Argumentations, the Number of all the *Britiſh Inſects* will amount to 2000, and the total Sum of thoſe of the whole Earth will be 20000. The Number of Plants contain'd in C. *Bauhin*'s *Penax* is about 6000, which are all that had been deſcrib'd by the Authors that wrote before him, or obſerv'd by himſelf; in which Work, beſides Miſtakes and Repetitions incident to the moſt wary and knowing Men in ſuch a Work as that, there are a great many, I might ſay ſome Hundreds, put down for different Species, which in my Opinion are but accidental Varieties: Which I do not ſay to detract from the excellent Pains and Performance of that Learned, Judicious and Laborious Herbariſt, or to defraud him of his deſerv'd Honour, but only to ſhew that he was too much ſway'd by the Opinions then generally current among Herbariſts, that different Colour or Multiplicity of Leaves in the Flower, and the like Accidents, were ſufficient to conſtitute a ſpecifick Difference. But ſuppoſing there had been 6000 then known and deſcrib'd; I cannot think but that there are in the World more than triple that Number; there being in the vaſt Continent of *America* as great a Variety of *Species* as with us, and yet but few common to *Europe*, or perhaps *Africk* and *Aſia*. And if, on the other Side the Equator, there be much Land ſtill remaining undiſcover'd as probably there may, we muſt ſuppoſe the Number of Plants to be far greater.

What can we infer from all this? If the Number of Creatures be ſo exceeding great, how great, nay immenſe, muſt needs be the Power and Wiſdom of him who form'd them all! For (that I may borrow the Words of a noble and excellent Author) as it argues and manifeſts more Skill by far in an Artificer, to be able to frame both *Clocks* and *Watches*, and *Pumps*, and *Mills*, and *Granadoes*, and *Rockets*, than he could diſplay in making but one of thoſe ſorts of Engines; ſo the Almighty diſcovers more of his Wiſdom in forming ſuch a vaſt Multitude of different Sorts of Creatures, and all with admirable and irreprovable Art, than if he had created but a few, for this declares the Greatneſs and unbounded Capacity of his Underſtanding. Again, the ſame Superiority of Knowledge would be diſplay'd, by contriving Engines of the ſame Kind, or for the ſame Purpoſes, after different Faſhions, as the moving of Clocks or other Engines by Springs inſtead of Weights: So the infinitely wiſe Creator hath ſhewn in many Inſtances, that he is not confin'd to one only Inſtrument for the working one Effect, but can perform the ſame thing by divers Means. So, tho' Feathers ſeem neceſſary for flying, yet hath he enabled ſeveral Creatures to fly without them, as two Sorts of Fiſhes, one Sort of Lizard, and the Batt, not to mention the numerous Tribes of flying Inſects. In like manner, tho' the Air-bladder in Fiſhes ſeems neceſſary for ſwimming, yet ſome are ſo form'd as to ſwim without it, *viz.* Firſt, the *Cartilagineous* Kind, which by what Artifice they poize themſelves, aſcend and deſcend at Pleaſure, and continue in what Depth of Water they liſt, is as yet unknown to us. Secondly, the *Cataceous* Kind, or Sea-beaſts, differing in nothing almoſt from Quadrupeds but the want of Feet. The Air which in Reſpiration theſe receive into their Lungs, may ſerve to render their Bodies equiponderant to the Water; and the Conſtriction or Dilatation of it, by the Help of the Diaphragm and Muſcles of Reſpiration, may probably aſſiſt them to aſcend or deſcend in the Water, by a light Impulſe thereof with their Fins.

Again; Tho' the Water being a cold Element, the moſt Wiſe GOD hath ſo attemper'd the Blood and Bodies of Fiſhes in general, that a ſmall degree of Heat is ſufficient to preſerve their due Conſiſtency and Motion, and to maintain Life; yet to ſhew that he can preſerve a Creature in the Sea, and in the coldeſt Part of the Sea too, that may have as great a degree of Heat as Quadrupeds themſelves, he hath Created variety of theſe Cetaceous Fiſhes, which converſe chiefly in the Northern Seas, whoſe whole Body being incompaſs'd round with a copious Fat or Blubber (which, by reflecting and redoubling the internal Heat, and keeping off the external

nal Cold, doth the ſame Thing to them that Clothes do to us) is enabled to abide the greateſt Cold of the Sea-water. The Reaſon why theſe *Fiſhes* delight to frequent chiefly the *Northern* Seas, is, I conceive, not only for the Quiet which they enjoy there, but becauſe the *Northern* Air, which they breath in, being more fully charg'd with thoſe Particles ſuppos'd nitrous, which are the Element of Fire, is fitteſt to maintain the vital Heat in that Activity which is ſufficient to move ſuch an unweildly Bulk as their Bodies are with due Celerity, and to bear up againſt and repel the ambient Cold; and may likewiſe enable them to continue longer under Water than a warmer and thinner Air could.

Another Inſtance to prove that GOD can and doth by different Means produce the ſame Effect, is the various Ways of extracting the nutritious Juice out of the Aliment, in ſeveral Kinds of Creatures.

1. In *Man* and *viviparous Quadrupeds* the Food moiſten'd with the Spittle [*ſaliva*] is firſt chew'd and prepar'd in the Mouth, then ſwallow'd into the Stomach, where being mingled with ſome diſſolvent Juices, it is by the Heat hereof concocted, macerated, and reduc'd into a Chyle or Cremor, and ſo evacuated into the Inteſtines, where being mix'd with the Choler and *Pancreatick* Juice, it is further ſubtiliz'd and render'd ſo fluid and penetrant, that the thinner and finer Part of it eaſily finds its Way in at the ſtreight Orifices of the lacteous Veins.

2. In *Birds* there is no Maſtication or Comminution of the Meat in the Mouth; but in ſuch as are not Carnivorous, it is immediately ſwallow'd into the Crop or Craw, or at leaſt into a Kind of Anteſtomach (which I have obſerv'd in many, eſpecially *Piſcivorous Birds*) where it is moiſtned and mollified by ſome proper Juice from the Glandules diſtilling in there, and thence transferr'd into the Gizzard or Muſculous Stomach, where by the working of the Muſcles compounding the Sides of that Ventricle, and by the Aſſiſtance of ſmall Pebbles (which the Creature ſwallows for that Purpoſe) it is, as it were by Mill-ſtones, ground ſmall, and ſo tranſmitted to the Guts, to be further attenuated and ſubtiliz'd by the foremention'd Choler and Pancreatick Juice.

3. In *oviparous Quadrupeds*, as *Chamelions*, *Lizards*, *Frogs*, as alſo in all Sorts of *Serpents*, there is no Maſtication or Comminution of the Meat either in Mouth or Stomach; but as they ſwallow *Inſects* or other Animals whole, ſo they avoid their Skins unbroken, having a Heat, or Spirits, powerful enough to extract the Juice they have Need of, without breaking that which contains it; as the *Pariſian Academiſts* tell us. I myſelf cannot warrant the Truth of the Obſervation in all. Here, by the by, we take Notice of the wonderful Dilatability or Extenſiveneſs of the Throats and Gullets of *Serpents*: I myſelf have taken two entire adult *Mice* out of the Stomach of an *Adder*, whoſe Neck was not bigger than my little Finger. Theſe Creatures, I ſay, draw out the Juice of what they ſwallow

without any Comminution, or ſo much as breaking the Skin; even as it is ſeen that the Juice of Grapes is drawn as well from the * Rape, where they remain whole, as from a Vat, where they are bruis'd; to borrow the *Pariſian* Philoſophers Similitude.

4. *Fiſhes*, which neither chew their Meat in their Mouths, nor grind it in their Stomachs, do by the Help of a diſſolvent Liquor, there by Nature provided, corrode and reduce it, Skin, Bones and all, into a *Chylus*, or *Cremor*; and yet (which may ſeem wonderful) this Liquor manifeſts nothing of Acidity to the Taſt: But notwithſtanding, how mild and gentle ſoever it ſeems to be, it corrodes Fleſh very ſtrangely and gradually, as *Aquafortis*, or the like corroſive Waters, do Metals, as appears to the Eye; for I have obſerv'd Fiſh in the Stomachs of others thus partially corroded, firſt the ſuperficial Part of the Fleſh, and then deeper and deeper by degrees to the Bones.

I come now to the ſecond Part of the Words, *In Wiſdom haſt thou made them all*; in diſcourſing whereof I ſhall endeavour to make out in Particulars what the *Pſalmiſt* here aſſerts in general concerning the Works of God, that they are all very wiſely contriv'd and adapted to Ends both particular and general.

But before I enter upon this Task, I ſhall, by Way of *Preface*, or *Introduction*, ſay ſomething concerning thoſe Syſtems which undertake to give an Account of the Formation of the Univerſe by Mechanical *Hypotheſes* of Matter, mov'd either uncertainly, or, according to ſome Catholick Laws, without the Intervention and Aſſiſtance of any ſuperior immaterial Agent.

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* Whole Grapes pluck'd from the Cluſter, and Wine pour'd upon them in a Veſſel.

There is no greater, at leaſt no more palpable and convincing Argument of the Exiſtence of a Deity, than the admirable Art and Wiſdom that diſcovers itſelf in the Make and Conſtitution, the Order and Diſpoſition, the Ends and Uſes of all the Parts and Members of this ſtately Fabrick of Heaven and Earth: For if in the Works of Art, as for Example, a curious Edifice, or Machine, Council, Deſign, and Direction, to an End appearing in the whole Frame, and in all the ſeveral Pieces of it, do neceſſarily infer the Being and Operation of ſome intelligent Architect, or Engineer, why ſhall not alſo, in the Works of Nature, that Grandeur and Magnificence, that excellent Contrivance for Beauty, Order, Uſe, *&c.* which is obſervable in them, wherein they do as much tranſcend the Effects of humane Art, as infinite Power and Wiſdom exceeds finite, infer the Exiſtence and Efficiency of an Omnipotent and All-wiſe Creator?

To evade the Force of this Argument, and to give ſome Account of the Original of the World, Atheiſtical Perſons have ſet up two *Hypotheſes*.

The firſt is that of *Ariſtotle*, that the World was from Eternity in the ſame Condition that now it is, having run through the Succeſſions of infinite Generations; to which they add, Self-exiſtent and unproduced: For *Ariſtotle* doth not deny God to be the *efficient Cauſe* of the World; but only aſſerts, that he created it from Eternity, making him a neceſſary Cauſe thereof; it proceeding from him by Way of Emanation, as Light from the Sun.

This *Hypotheſis*, which hath ſome Shew of Reaſon, for ſomething muſt neceſſarily exiſt of itſelf; and if ſomething, why may not all Things? This *Hypotheſis*, I ſay, is ſo clearly and fully confuted by the Reverend and Learned Dr. *Tillotſon*, late Lord Archbiſhop of *Canterbury*, and Primate of all *England*, in his firſt printed Sermon, and the Right Reverend Father in God, *John*, late Lord Biſhop of *Cheſter*, in Book I. Chap. V. of his Treatiſe of the *Principles of Natural Religion*, that nothing material can by me be added: To whom therefore I refer the Reader.

The Epicurean *Hypotheſis rejected.*

The ſecond *Hypotheſis* is that of the *Epicureans*, who held, that there were two Principles ſelf-exiſtent. Firſt, *Space*, or *Vacuity*; Secondly, *Matter*, or *Body*; both of infinite Duration and Extenſion. In this infinite Space, or Vacuity, which hath neither Beginning, nor End, nor Middle, no Limits, or Extreams, innumerable minute Bodies, into which the Matter was divided, call'd *Atoms*, becauſe by Reaſon of their perfect Solidity they were really indiviſible (for they hold no Body capable of Diviſion,

viſion, but what hath Vacuities interſpers'd with Matter, of various but a determinate Number of Figures, and equally ponderous, do perpendicularly deſcend, and by their fortuitous Concourſe make compound Bodies, and at laſt the World itſelf. But now, becauſe if all theſe Atoms ſhould deſcend plum down with equal Velocity, as according to their Doctrine they ought to do, being (as we ſaid) all perfectly ſolid and imporous, and the *Vacuum* not reſiſting their Motion, they would never the one overtake the other, but like the Drops of a Shower would always keep the ſame Diſtances, and ſo there could be no Concourſe, or Cohæſion of them, and conſequently nothing created; partly to avoid this deſtructive Conſequence, and partly to give ſome Account of the Freedom of Will, (which they did aſſert contrary to the *Democratick* Fate) they did abſurdly feign a Declination of ſome of theſe Principles, without any Shadow, or Pretence of Reaſon. The former of theſe Motives you have ſet down by *Lucretius de Nat. Rerum*, L. 2. in theſe Words:

Corpora cum deorſum rectum per inane feruntur
Ponderibus propriis, incerto Tempore forté,
Incertiſque locis, Spatio diſcedere paulùm;
Tantum quod nomen mutatum dicere poſſis.

And again;

Quod niſi declinare ſolerent, omnia deorſum
Imbris uti guttæ caderent per inane profundum,
Nec foret offenſus natus, nec plaga creata
Principiis, ita nil unquam natura creaſſet.

Now Seeds in downward Motion muſt decline,
Tho' vary little from th' exacteſt Line;
For did they ſtill move ſtrait, they needs muſt fall
Like Drops of Rain, diſſolv'd and ſcatter'd all,
For ever tumbling thro' the mighty Space,
And never join to make one ſingle Maſs.

The ſecond Motive they had to introduce this gratuitous Declination of Atoms, the ſame Poet gives us in theſe Verſes, *Lib.* 2.

——Si ſemper motus connectitur omnis,
Et vetere exoritur ſemper novus ordine certo;
Nec declinando faciunt primordia motûs
Principium quoddam quod fati fœdera rumpat,
Ex infinito nè cauſam cauſa ſequatur;
Libera per terras unde hæc animantibus, extat,
Unde hæc eſt, inquam, fatis avolſa voluntas?

Beſides, did all Things move in direct Line,
And ſtill one Motion to another join
In certain Order, and no Seeds decline,
And make a Motion fit to diſſipate
The well-wrought Chain of Cauſes and ſtrong Fate;
Whence comes that Freedom living Creatures find?
Whence comes the Will ſo free, ſo unconfin'd,
Above the Power of the Fate?

The Folly and Unreaſonableneſs of this ridiculous and ungrounded Figment, I cannot better diſplay and reprove than in the Words of *Cicero*, in the Beginning of his firſt Book *de Finibus Bonorum & Malorum.* This Declination (ſaith he) is altogether childiſhly feign'd, and yet neither doth it at all ſolve the Difficulty, or effect what they deſire: For firſt, They ſay the Atoms decline, and yet aſſign no Reaſon why. Now nothing is more ſhameful and unworthy a Natural Philoſopher [*turpius Phyſico*] than to aſſert any thing to be done without a Cauſe, or to give no Reaſon of it. Beſides, this is contrary to their own *Hypotheſis* taken from Sence, that all Weights do naturally move perpendicularly downward. Secondly, Again ſuppoſing this were true, and that there were ſuch a Declination of Atoms, yet will it not effect what they intend; for either they do all decline, and ſo there will be no more Concourſe than if they did perpendicularly deſcend; or ſome decline, and ſome fall plum down, which is ridiculouſly to aſſign diſtinct Offices and Tasks to the Atoms, which are all of the ſame Nature and Solidity. Again, in his Book *de Fato*, he ſmartly derides this fond Conceit thus; What Cauſe is there in Nature which turns the Atoms aſide? Or do they caſt Lots among themſelves which ſhall decline, which not? Or why do they decline the leaſt Interval that may be, and not a greater? why not two or three *minima* as well as one? *Optare hoc quidem eſt non diſputare.* For neither is the Atom by any extrinſical Impulſe diverted from its natural Courſe; neither can there be any Cauſe imagin'd in the Vacuity through which it is carried, why it ſhould not move directly; neither is there any Change made in the Atom itſelf, that it ſhould not retain the Motion natural to it, by Force of its Weight or Gravity.

As for the whole *Atomical Hypotheſis*, either *Epicurean* or *Democritick*, I ſhall not, nor need I, ſpend Time to confute it; this having been already ſolidly and ſufficiently done by many learned Men, but eſpecially Dr. *Cudworth*, in his *Intellectual Syſtem of the Univerſe*, and the late Biſhop of *Worceſter*, Dr. *Stillingfleet*, in his *Origines Sacræ*. Only I cannot omit the *Ciceronian* Confutation thereof, which I find in the Place firſt quoted, and in his firſt and ſecond Books *de Naturâ Deorum*, becauſe it may ſerve as a general Introduction to the following Particulars. Such a turbulent Concourſe of Atoms could never, (ſaith he) *hunc mundi ornatum efficere*, compoſe ſo well-order'd and beautiful a Structure as the *World*; which therefore both in *Greek* and *Latin* hath from thence [*ab ornatu & munditie*] obtain'd its Name. And again moſt fully and appoſitely in his ſecond *de Nat. Deorum*: If the Works of *Nature* are better, more exact and perfect, than the Works of *Art*, and *Art* effects nothing without Reaſon, neither can the Works of *Nature* be thought to be effected without Reaſon; for, is it not abſurd and incongruous, that when thou beholdeſt a Statue or curious Picture, thou ſhouldſt acknowledge that Art was us'd to the making of it; or when thou ſeeſt the Courſe of a Ship upon the Waters, thou ſhouldſt not doubt but the Motion of it is regulated and directed by Reaſon and Art; or when thou conſidereſt a Sun-dyal or Clock, thou ſhouldſt underſtand preſently, that the Hours are ſhewn by Art, and not by Chance; and yet imagine or believe, that the World, which comprehends all theſe Arts and Artificers, was made without Counſel or Reaſon? If one ſhould carry into *Scythia* or *Britain* ſuch a Sphere as our Friend *Poſſidonius* lately made, each of whoſe Converſions did the ſame Thing in the *Sun*, and *Moon*, and other five *Planets*, which we ſee effected every Night and Day in the Heavens, who among thoſe Barbarians would doubt that that Sphere was compos'd by Reaſon and Art? A Wonder then it muſt needs be, that there ſhould be any Man found ſo ſtupid and forſaken of Reaſon, as to perſuade himſelf, that this moſt beautiful and adorn'd World was, or could, be produc'd by the fortuitous Concourſe of Atoms. He that can prevail with himſelf to believe this, I do not ſee why he may not as well admit, that if there were made innumerable Figures of the one and twenty Letters, in Gold, ſuppoſe, or any other Metal, and theſe well ſhaken and mixt together, and thrown down from ſome high Place to the Ground, they when they lighted upon the Earth would be ſo diſpos'd and rank'd that a Man might ſee and read in them *Ennius's Annals*; whereas it were a great Chance if he ſhould find one Verſe thereof among them all: For if this Concourſe of Atoms could make a whole World, why may it not ſometimes make, and why hath it not ſomewhere or other in the Earth made, a Temple, or a Gallery, or a *Portico*, or a Houſe, or a City? which yet is ſo far from doing, and every Man ſo far from believing, that ſhould any one of us be caſt, ſuppoſe, upon a deſolate *Iſland*, and find there a magnificent Palace, artificially contriv'd according to the exacteſt Rules of Architecture, and curiouſly adorn'd and furniſh'd, it would never once enter into his Head, that this was done by an Earthquake, or the fortuitous Shuffling together of its compotent Materials; or that it had ſtood there ever ſince the Conſtruction of the *World*, or firſt Cohæſian of *Atoms*; but would preſently conclude, that there had been ſome intelligent Architect there, the Effect of whoſe Art and Skill it was. Or ſhould he find there but one ſingle Sheet of Parchment or Paper, an Epiſtle or Oration written, full of profound Senſe, expreſs'd in proper and ſignificant Words, illuſtrated and adorn'd with elegant Phraſe; it were beyond the Poſſibility of the Wit of Man to perſuade him that this was done by the temerarious Daſhes of an unguided Pen, or by the rude Scattering of Ink upon the Paper, or by the lucky Projection of ſo many Letters at all Adventures; but he would be convinc'd by the Evidence of the Thing at firſt Sight, that there had been not only ſome Man, but ſome Scholar there.

The Carteſian Hypotheſis *conſider'd and cenſur'd.*

Having rejected this *Atheiſtick Hypotheſis* of

Epicurus and *Democritus*, I ſhould now proceed to give particular Inſtances of the Art and Wiſdom clearly appearing in the ſeveral Parts and Members of the Univerſe; from which we may juſtly infer this general Concluſion of the Pſalmiſt, *In Wiſdom haſt thou made them all:* But that there is a Sort of profeſſed *Theiſts*, I mean, Monſ. *Des Cartes*, and his Followers, who endeavour to diſarm us of this decretory Weapon, to evacuate and exterminate this Argument, which hath been ſo ſucceſsful in all Ages to demonſtrate the Exiſtence, and enforce the Belief of a Deity, and to convince and ſilence all Atheiſtick Gainſayers. And this they do,

Firſt, By excluding and baniſhing all Conſideration of final Cauſes from Natural Philoſophy, upon Pretence, that they are all and every one in particular undiſcoverable by us; and that it is Raſhneſs and Arrogance in us to think we can find out God's Ends, and be Partakers of his Councils. *Atque ob hanc unicam rationem, totum illud cauſarum genus quod à fine peti ſolet, in rebus Phyſicis nullum uſum habere exiſtimo; non enim abſque temeritate me puto inveſtigare poſſes fines Dei.* Medit. Metaph. *And for this only Reaſon, I think, all that Lind of Cauſes which is wont to be taken from the End, to have no Uſe in Phyſics or natural Matters; for I cannot without Raſhneſs think my ſelf able to find out the Ends of God.* And again, in his *Principles of Philoſophy; Nullas unquam rationes circa res Naturales, à fine quem Deus aut Natura in iis faciendis ſibi propoſuit, admittimus, quia non tantum nobis de-*

bemus arrogare ut ejus Conciliorum participes eſſe poſſimus. We can by no Means admit any Reaſons about natural Things, taken from the End which God or Nature propos'd to themſelves in making of them; becauſe we ought not to arrogate ſo much to ourſelves, as to think we may be Partakers of his Councils. And more expreſly in his fourth Anſwer, *viz.* to *Gaſſendus*'s Objections; *Nec fingi poteſt, aliquos Dei fines magis quàm alios in propatulo eſſe; omnes enim imperſcrutabili ejus Sapientiæ abyſſo ſunt eodem modo reconditi:* That is, *Neither can nor ought we to feign or imagine that ſome of God's Ends are more manifeſt than others; for all lie in like Manner, or equally hidden, in the unſearchable Abyſs of his* Wiſdom.

This confident Aſſertion of *Des Cartes* is fully examin'd and reprov'd by that honourable and excellent Perſon, Mr. *Boyle*, in his *Diſquiſition about the final Cauſes of Natural Things*, Sect. 1. from Page 10. to the End; and therefore I ſhall not need ſay much to it, only in brief this, that it ſeems to me falſe, and of evil Conſequence, as being derogatory from the Glory of God, and deſtructive of the Acknowledgment and Belief of a Deity:

For firſt, Seeing (for Inſtance) that the Eye is imploy'd by Man and all Animals for the Uſe of Viſion, which, as they are fram'd, is ſo neceſſary for them, that they could not live without it; and God Almighty knew that it would be ſo; and ſeeing it is ſo admirably fitted and adapted to this Uſe, that all the *Wit* and

Art of Men and Angels could not have contriv'd it better, if ſo well, it muſt needs be highly abſurd and unreaſonable to affirm, either that it was not deſign'd at all for this Uſe, or that it is impoſſible for Man to know whether it was or not.

Secondly, How can Man give Thanks and Praiſe to God for the Uſe of his Limbs and Senſes, and thoſe his good Creatures which ſerve for his Suſtenance, when he cannot be ſure they were made in any Reſpect for him; nay, when 'tis as likely they were not, and that he doth but abuſe them to ſerve Ends for which they were never intended?

Thirdly, This Opinion, as I hinted before, ſuperſedes and caſſates the beſt *Medium* we have to demonſtrate the Being of a Deity, leaving us no other demonſtrative Proof but that taken from the innate *Idea*; which, if it be a Demonſtration, is but an obſcure one, not ſatisfying many of the Learned themſelves, and being too ſubtle and metaphiſical to be apprehended by vulgar Capacities, and conſequently of no Force to perſuade and convince them.

Secondly, They endeavour to evacuate and diſannul our great Argument, by pretending to ſolve all the *Phænomena* of Nature, and to give an Account of the Production and Efformation of the Univerſe, and all the corporeal Beings therein, both celeſtial and terreſtrial, as well animate as inanimate, not excluding Animals themſelves, by a ſlight *Hypotheſis* of Matter ſo and ſo divided and mov'd. The *Hypotheſis* you have in *Des Cartes's Principles of Philoſophy*, Part 2. *All the Matter of this viſible World is* by him ſuppos'd *to have been at firſt divided by God into Parts nearly equal to each other, of a mean Size,* viz. *about the Bigneſs of thoſe whereof the Heavenly Bodies are now compounded; all together having as much Motion as is now found in the World; and theſe to have been equally mov'd ſeverally every one by itſelf about its own Centre, and among one another, ſo as to compoſe a fluid Body; and alſo many of them jointly, or in company, about ſeveral other Points ſo far diſtant from one another, and in the ſame Manner diſpos'd as the Centres of the fix'd Stars now are.* So that God had no more to do than to create the Matter, divide it into Parts, and put it into Motion, according to ſome few Laws, and that would of itſelf produce the World, and all Creatures therein.

For a Confutation of this *Hypotheſis*, I might refer the Reader to Dr. *Cudworth*'s Syſtem, *p.* 603, 604. but for his Eaſe I will tranſcribe the Words: ------ God, in the mean Time, ſtanding by as an idle Spectator of this *Lucus Atomorum*, this ſportful Dance of *Atoms*, and of the various Reſults thereof. Nay, theſe *mechanick Theiſts* have here quite outſtripp'd and outdone the *Atomick Atheiſts* themſelves, they being much more extravagant than ever thoſe were; for the profeſſed *Atheiſts* durſt never venture to affirm, that this regular *Syſtem* of Things reſulted from the *fortuitous Motions* of Atoms at the very firſt, before they had for a long Time together produced many other *inept Combinations*, or *aggregate*

Forms of particular Things and *nonſenſical Syſtems* of the Whole; and they ſuppos'd alſo, that the *Regularity* of Things here in this World would not always continue ſuch neither, but that ſome Time, or other, Confuſion and Diſorder will break in again. Moreover, that beſides this World of ours, there are at this very Inſtant innumerable other Worlds *irregular*, and that there is but one of a Thouſand, or Ten Thouſand among the infinite Worlds that have ſuch Regularity in them; the Reaſon of all which is, becauſe it was generally taken for granted, and look'd upon as a common Notion, that τῶν ἀπὸ τύχης καὶ τοῦ αὐτομάτου οὐδὲν ἀεὶ οὕτω γίνεται, as *Ariſtotle* expreſſeth it; none of thoſe Things which are from Fortune, or Chance, come to paſs always alike. But our *mechanick Theiſts* will have their Atoms never ſo much as once to have fumbled in theſe their Motions, nor to have produc'd any inept Syſtem, or incongruous Forms at all, but from the very firſt all along to have taken up their Places, and ranged themſelves ſo orderly, methodically and directly, as that they could not poſſibly have done it better had they been directed by the moſt perfect Wiſdom. Wherefore theſe *Atomick Theiſts* utterly evacuate that grand Argument for a God, taken from the *Phænomenon* of the Artificial Frame of Things, which hath been ſo much inſiſted upon in all Ages, and which commonly makes the ſtrongeſt Impreſſion of any other upon the Minds of Men, *&c.* the *Atheiſts*, in the mean Time, laughing in their *Sleeves*, and not a little triumphing to ſee the

Cauſe of *Theiſm* thus betray'd by its profeſs'd Friends and Aſſerters, and the grand Argument for the ſame totally ſlurr'd by them, and ſo their Work done, as it were, to their Hands.

Now as this argues the greateſt Inſenſibility of Mind, or Sottiſhneſs and Stupidity in pretended *Theiſts*, not to take the leaſt Notice of the regular and artificial Frame of Things, or of the Signatures of the Divine Art and Wiſdom in them, nor to look upon the *World* and *Things of Nature* with any other Eyes than Oxen and Horſes do; ſo are there many *Phænomenas* in Nature, which being partly above the Force of theſe *mechanick Powers*, and partly contrary to the ſame, can therefore never be ſalv'd by them, nor without *final Cauſes*, and ſome *vital Principles*: As for Example, that of Gravity, or the Tendency of Bodies downward, the Motion of the *Diaphragm* in Reſpiration, the *Syſtole* and *Diaſtole* of the Heart, which is nothing but a Muſcular Conſtriction and Relaxation, and therefore not *mechanical*, but *vital*. We might alſo add, among many others, the Interſection of the Plains of the *Equator* and *Ecliptick*, or the Earth's diurnal Motion upon an *Axis* not parallel to that of the *Ecliptick*, nor perpendicular to the Plain thereof: For tho' *Des Cartes* would needs imagine this Earth of ours once to have been a Sun, and ſo itſelf the Centre of a leſſer *Vortex*, whoſe *Axis* was then directed after this Manner, and which therefore ſtill kept the ſame Site or Poſture, by Reaſon of the ſtrait Particles finding no fit Pores, or Traces, for their Paſſages through it, but only in this Direction; yet does he himſelf confeſs, that becauſe theſe two Motions of the Earth, the Annual and Diurnal, would be much more conveniently made upon parallel *Axes*, therefore, according to the Laws of Mechaniſm, they ſhould be perpetuately brought nearer and nearer together, 'till at length the *Equator* and *Ecliptick* come to have their *Axes* parallel, which, as it hath not yet come to paſs, ſo neither hath there been for theſe laſt Two Thouſand Years (according to the beſt Obſervations and Judgments of Aſtronomers) any nearer Approach made of them one to another. Wherefore the Continuation of theſe two Motions of the Earth, the Annual and Diurnal, upon *Axes* not parallel, is reſolvable into nothing but a *final* and *mental* Cauſe, or the τὸ Βέλτιϛον, becauſe it was beſt it ſhould be ſo, the Variety of the Seaſons of the Year depending thereupon. But the greateſt of all the particular *Phænomena*, is the Formation and Organization of the Bodies of Animals, conſiſting of ſuch Variety and Curioſity, that theſe mechanick Philoſophers being no Way able to give an Account thereof from the neceſſary Motion of Matter, *unguided by Mind for Ends*, prudently therefore break off their Syſtem there, when they ſhould come to Animals, and ſo leave it altogether untouch'd. We acknowledge indeed there is a *Poſthumous* Piece extant, imputed to *Cartes*, and entitled, *De la Formation du Fœtus*, wherein there is ſome Pretence made to ſalve all this fortuitous Mechaniſm. But as the Theory thereof is built wholly upon a falſe Suppoſition, ſufficiently confuted by our *Harvey* in his Book of *Generation*, *That the Seed doth materially enter into the Compoſition of the Egg*; ſo is it all along precarious and exceptionable: Nor doth it extend at all to Differences that are in ſeveral *Animals*, nor offer the leaſt Reaſon why an *Animal* of one *Species* might not be form'd out of the Seed of another. Thus far the *Doctor*, with whom for the main I do conſent. I ſhall only add, that Natural Philoſophers, when they endeavour to give an Account of any of the Works of Nature by preconceiv'd Principles of their own, are for the moſt Part groſly miſtaken and confuted by Experience; as *Des Cartes* in a Matter that lay before him, obvious to Senſe, and infinitely more eaſie to find out the Cauſe of, than to give an Account of the Formation of the World; that is, the Pulſe of the Heart, which he attributes to an Ebullition and ſudden Expanſion of the Blood in its Ventricles, after the Manner of the Milk, which being heated to ſuch a Degree, doth ſuddenly, and as it were all at once, fluſh up and run over the Veſſel. Whether this Ebullition be caus'd by a Nitro-Sulphureous Ferment lodg'd eſpecially in the left Ventricle of the Heart, which mingling with the Blood, excites ſuch an Ebullition, as we ſee made by the Mixture of ſome Chymical Liquors, *viz.* Oil of Vitriol, and deliquated Salt of Tartar; or, by the vital Flame warming and boiling the Blood. But this Conceit of his is contrary both to Reaſon and Experience: For, firſt, it is altogether unreaſonable to imagine and affirm that the cool venal Blood ſhould be heated to ſo high a Degree in ſo ſhort a Time as the Interval of two Pulſes, which is leſs than the ſixth Part of a Minute. Secondly, in cold Animals, as for Example, *Eels*, the Heart will beat for many Hours after it is taken out of the Body, yea, tho' the Ventricle be open'd, and all the Blood ſqueez'd out. Thirdly, The Proceſs of the Fibres which compound the Sides of the Ventricles running in Spiral Lines from the Tip to the Baſe of the Heart, ſome one Way, and ſome the contrary, do clearly ſhew that the *Syſtole* of the Heart is nothing but a Muſcular Conſtriction, as a Purſe is ſhut by drawing the Strings contraryways; which is alſo confirm'd by Experience: For if the *Vertex* of the Heart be cut off, and a Finger thruſt up into one of the Ventricles, in every *Syſtole* the Finger will be ſenſibly and manifeſtly pinch'd by the Sides of the Ventricle. But for a full Confutation of this Fancy, I refer the Reader to Dr. *Lower*'s Treatiſe *de Corde*, *cap.* 2. and *Des Cartes*'s Rules concerning the transferring of Motion from one Body in Motion to another in Motion, or in Reſt, are the moſt of them by Experience found to be falſe; as they affirm who have made Trial of them.

This Pulſe of the Heart Dr. *Cudworth* would have to be no Mechanical, but a Vital Motion, which to me ſeems probable, becauſe it is not under the Command of the Will; nor are we conſcious of any Power to cauſe, or to reſtrain it, but it is carried on and continued without our

Knowledge, or Notice; neither can it be cauſed by the Impulſe of any external Movent, unleſs it be Heat. But how can the Spirit, agitated by Heat, unguided by a *vital Principle*, produce ſuch a regular reciprocal Motion? If that Site which the Heart and its Fibres have in the *Diaſtole* be moſt natural to them, (as it ſeems to be) why doth it again contract itſelf, and not reſt in that Poſture? If it be once contracted in a *Syſtole* by the Influx of the Spirits, why, the Spirits continually flowing in without Let, doth it not always remain ſo? [for the *Syſtole* ſeems to reſemble the forcible Bending of a Spring, and the *Diaſtole* its flying out again to its natural Site.] What is the Spring and principal Efficient of this Reciprocation? What directs and moderates the Motions of the Spirits? They being but ſtupid and ſenſeleſs Matter, cannot of themſelves continue any regular and conſtant Motion, without the Guidance and Regulation of ſome intelligent Being. You will ſay, What Agent is it which you would have to effect this? The ſenſitive Soul it cannot be, becauſe that is indiviſible; but the Heart, when ſeparated wholly from the Body in ſome *Animals*, continue ſtill to pulſe for a conſiderable Time: Nay, when it hath quite ceas'd, it may be brought to beat a-new by the Application of warm Spittle, or by pricking it gently with a Pin, or Needle. I anſwer, it may be in theſe Inſtances, the ſcattering Spirits remaining in the Heart, may for a Time, being agitated by the Heat, cauſe theſe faint Pulſations; tho' I ſhould rather attribute them to a *plaſtick*

Nature, or Vital Principle, as the Vegetation of Plants muſt alſo be.

But, to proceed, neither can I wholly acquieſce in the *Hypotheſis* of that *Honourable and deſervedly Famous Author*, I formerly had Occaſion to mention, which I find in his *free Inquiry into the vulgar Notion of Nature*, p. 77, 78. deliver'd in theſe Words. "I think it probable, "that the great and wiſe Author of Things did, "when he firſt form'd the Univerſe and undiſtinguiſh'd Matter into the World, put its Parts "into various Motions, whereby they were neceſſarily divided into numberleſs Portions of "differing Bulks, Figures, and Situations, in Reſpect of each other: And that by his infinite "Wiſdom and Power he did ſo guide and overrule the Motions of theſe Parts, at the Beginning of Things, as that (whether in a ſhorter "or a longer Time Reaſon cannot determine) "they were finally diſpos'd into that beautiful "and orderly Frame that we call the *World*; "among whoſe Parts ſome were ſo curiouſly "contriv'd, as to be fit to become the Seeds, or "ſeminal Principles, of Plants and Animals. "And, I further conceive, that he ſettled ſuch "Laws, or Rules, of local Motion among the "Parts of the Univerſal Matter, that by his ordinary and preſerving Concourſe, the ſeveral "Parts of the Univerſe thus once compleated, "ſhould be able to maintain the great Conſtruction, or Syſtem, and Oeconomy of the "Mundane Bodies, and propagate the Species "of living Creatures." The ſame *Hypotheſis* he repeats again, *pag.* 124, 125. of the ſame Treatiſe.

This *Hypotheſis*, I ſay, I cannot fully acquieſce in, becauſe an intelligent Being ſeems to me requiſite to execute the Laws of Motion: For firſt, Motion being a fluent Thing, and one Part of its Duration being abſolutely independent upon another, it doth not follow, that becauſe any thing moves this Moment, it muſt neceſſarily continue to do ſo the next, unleſs it were actually poſſeſs'd of its future Motion; which is a Contradiction; but it ſtands in as much Need of an Efficient to preſerve and continue its Motion, as it did at firſt to produce it. Secondly, Let Matter be divided into the ſubtileſt Parts imaginable, and theſe be mov'd as ſwiftly as you will, it is but a ſenſeleſs and ſtupid Being ſtill, and makes no nearer approach to Senſe, Perception, or vital Energy, than it had before; and do but only ſtop the internal Motion of its Parts, and reduce them to Reſt, the fineſt and moſt ſubtil Body that is, may become as groſs, and heavy, and ſtiff, as Steel, or Stone. And, as for any external Laws, or eſtabliſh'd Rules of Motion, the ſtupid Matter is not capable of obſerving, or taking any Notice of them, but would be as ſullen as the Mountain was that *Mahomet* commanded to come down to him; neither can thoſe Laws execute themſelves. Therefore there muſt, beſides Matter and Law, be ſome Efficient, and that either a Quality, or Power, inherent in the Matter itſelf, which is hard to conceive; or ſome external intelligent Agent, either God himſelf immediately, or ſome *Plaſtick Nature.*

Happening lately to read *The Chriſtian Virtuoſo*, written by the ſame Author of the *Enquiry into the vulgar Notions of Nature*, (the illuſtrious Mr. *Boyle*) I find therein theſe Words: "Nor will the Force of all that has been ſaid "for God's ſpecial Providence be eluded, by "ſaying with ſome Deiſts, That after the firſt "Formation of the Univerſe, all Things were "brought to paſs by the ſettled Laws of Nature. "For though this be confidently, and not with"out Colour, pretended, yet, I confeſs, it doth "not ſatisfie me: ---- For I look upon a Law as "a Moral, not Phyſical Cauſe, as being indeed "but a notional Thing, according to which an "intelligent and free Agent is bound to regulate "its Actions. But inanimate Bodies are utterly "uncapable of underſtanding what it is, or what "it enjoins, or when they act conformably, or "unconformably to it: Therefore the Actions "of inanimate Bodies, which cannot incite, or "moderate their own Actions, are produced by "real Power, not by Laws."

All this being conſonant to what I have here written, againſt what I took to be this Honourable Perſon's *Hypotheſis*, I muſt needs, to do him Right, acknowledge myſelf miſtaken; perceiving now, that his Opinion was, that God Almighty did not only eſtabliſh Laws and Rules of local Motion among the Parts of the univerſal Matter, but did, and does alſo himſelf, execute them, or move the Parts of Matter, according to them: So that we are in the main agreed, differing chiefly about the Agent that executes thoſe Laws, which he holds to be God himſelf immediately, we a Plaſtick Nature; for the Reaſons alledg'd by Dr. *Cudworth*, in his Syſtem, *pag.* 149. which are, Firſt, Becauſe the former, according to vulgar Apprehenſion, would render the Divine Providence operoſe, ſolicitous, and diſtractious; and thereby make the Belief of it entertain'd with greater Difficulty, and give Advantage to Atheiſts. Secondly, It is not ſo decorous in Reſpect of God, that he ſhould αὐτουργεῖν ἅπαντα, ſet his own Hand, as it were, to every Work, and immediately do all the meaneſt and trifling'ſt Things himſelf drudgingly, without making Uſe of any inferiour or ſubordinate Miniſter. Theſe two Reaſons are plauſible, but not cogent; the two following are of greater Force. Thirdly, The ſlow and gradual Proceſs that is in the Generation of Things, which would ſeem to be a vain and idle Pomp, or trifling Formality, if the Agent were omnipotent. Fourthly, Thoſe ἁμαρτήματα, as *Ariſtotle* calls them, thoſe Errors and Bungles which are committed when the Matter is inept, or contumacious, as in Monſters, *&c.* which argue the Agent not to be irreſiſtible; and that Nature is ſuch a Thing as is not altogether uncapable, as well as Humane Art, of being ſometimes fruſtrated and diſappointed by the Indiſpoſition of the Matter: Whereas an Omnipotent Agent would always do its Work infallibly and irreſiſtibly, no Ineptitude, or Stubborneſs of the Matter being ever able to hinder ſuch an one, or make him bungle, or fumble in any thing. So far the Doctor. For my Part, I ſhould make no Scruple to attribute the Formation of *Plants*, their Growth and Nutrition, to the vegetative Soul in them; and likewiſe the Formation of *Animals*, to the vegetative Power of their Souls; but that the Segments and Cuttings of ſome Plants, nay, the very Chips and ſmalleſt Fragments of their Body, Branches, or Roots, will grow and become perfect Plants themſelves, and ſo the vegetative Soul, if that were the Architect, would be diviſible, and conſequently no ſpiritual, or intelligent Being; which the *Plaſtick Principle* muſt be, as we have ſhewn: For that muſt preſide over the whole Oeconomy of the Plant, and be one ſingle Agent, which takes Care of the Bulk and Figure of the Whole, and the Situation, Figure, Texture of all the Parts, Root, Stalk, Branches, Leaves, Flowers, Fruit, and all their Veſſels and Juices. I therefore incline to Dr. *Cudworth*'s Opinion, that God uſes for theſe Effects the ſubordinate Miniſtry of ſome inferiour *Plaſtick Nature*; as, in his Works of Providence, he doth of Angels. For the Deſcription whereof I refer the Reader to his *Syſtem*.

Secondly, In particular I am difficult to believe, that the *Bodies* of *Animals* can be form'd by Matter divided and mov'd by what Laws you will, or can imagine, without the immediate Preſidency, Direction, and Regulation of ſome intelligent Being. In the Generation, or firſt Formation of, ſuppoſe, the Humane Body out of (tho' not an Homogeneous Liquor, yet) a fluid Subſtance, the only material Agent, or Mover, is a moderate Heat. Now how this, by producing an inteſtine Motion in the Particles of the Matter, which can be conceiv'd to differ in nothing elſe but Figure, Magnitude, and Gravity, ſhould, by Vertue thereof, not only ſeparate the Heterogeneous Parts, but aſſemble the Homogeneous into Maſſes, or Syſtems, and that not each Kind into one Maſs, but into many and disjoin'd ones, as it were ſo many Troops; and that in each Troop the particular Particles ſhould take their Places, and caſt themſelves into ſuch a Figure; as for Example, the Bones, being about 300, are form'd of various Sizes and Shapes, ſo ſituate and connected, as to be ſubſervient to many hundred Intentions and Uſes, and many of them conſpire to one and the ſame Action, and all this contrarily to the Laws of Specifick Gravity, in whatever Poſture the Body be form'd; for the Bones, whoſe component Parts are the heavier, will be above ſome Parts of the Fleſh which are the lighter; how much more then, ſeeing it is form'd with the Head, (which for its Bigneſs is the heavieſt of all the Parts) uppermoſt. This, I ſay, I cannot by any Means conceive. I might inſtance in all the Homogeneous Parts of the Body, either Sites and Figures, and ask by what imaginable Laws of Motion their Bulk, Figure, Situation, and Connection can be made out? What Account can be given of the Valves, of the Veins and Arteries of the Heart, and of the Veins elſewhere, and of their Situation; of the Figure and Conſiſtency of all the Humours and Membranes of the Eye, all conſpiring and exactly fitted to the Uſe of Seeing? But I have touch'd upon that already, and ſhall diſcourſe of it largely afterward. You will ask me, Who, or what, is the Operator in the Formation of the Bodies of Man, and other Animals? I anſwer, The ſenſitive Soul itſelf, if it be a ſpiritual and immaterial Subſtance, as I am inclinable to believe; but if it be material, and conſequently the whole *Animal* but a meer Machine, or *Automaton*, as I can hardly admit, then muſt we have recourſe to a *Plaſtick Nature*.

That the Soul of Brutes is material, and the whole Animal, Soul and Body, but a meer Machine, is the Opinion, publickly own'd and declar'd, of *Des Cartes*, *Gaſſendus*, Dr. *Willis*, and others. The ſame is alſo neceſſarily conſequent upon the Doctrine of the Peripateticks, *viz.* That the ſenſitive Soul is educed out of the Power of the Matter, for nothing can be educed out of the Matter but what was there before; which muſt be either Matter, or ſome Modification of it. And therefore they cannot grant it to be a ſpiritual Subſtance, unleſs they will aſſert it to be educed out of nothing. This Opinion, I ſay, I can hardly digeſt: I ſhould rather think Animals to be endu'd with a lower Degree of Reaſon, than that they are meer Machines. I could inſtance in many Actions of *Brutes*, that are hardly to be accounted for without Reaſon and Argumentation; as that commonly noted of Dogs, that running before their Maſters, they will ſtop at a Divarication of the Way, 'till they ſee which Hand their Maſters will take; and that when they have gotten a Prey, which they fear their Maſters will take from them, they will run away and hide it, and afterwards return to it. What Account can be given why a Dog, being to leap upon a Table which he ſees to be too high for him to reach at once, if a Stool, or Chair, happens to ſtand near it, doth firſt mount up that, and from thence the Table? If he were a Machine, or Piece of Clockwork, and this Motion caus'd by the ſtriking of a Spring, there is no Reaſon imaginable why the Spring being ſet on Work, ſhould not carry the Machine in a right Line toward the Object that put it in Motion, as well when the Table is high as when it is low; whereas I have often obſerv'd the firſt Leap the Creature hath taken up the Stool, not to be directly toward the Table, but in a Line oblique, and much declining from the Object that mov'd it, or that Part of the Table on which it ſtood.

Many the like Actions there are, which I ſhall not ſpend Time to relate. Should this be true, that Beaſts were *Automata*, or Machines, they could have no Senſe, or Perception of Pleaſure, or Pain, and conſequently no Cruelty could be exercis'd towards them; which is contrary to the doleful Significations they make when beaten, or tormented, and contrary to the common Senſe of Mankind, all Men naturally pitying them, as apprehending them to have ſuch a

Senſe and Feeling of Pain and Miſery as themſelves have; whereas no Man is troubled to ſee a Plant torn, or cut, or ſtampt, or mangled how you pleaſe; and at laſt ſeemingly contrary to the Scripture too; for it is ſaid, *Prov.* xii. 10. *A righteous Man regardeth the Life of his Beaſt, but the tender Mercies of the Wicked are cruel.* The former Clauſe is uſually Engliſh'd, *A good Man is merciful to his Beaſt*; which is the true Expoſition of it; as appears by the oppoſite Clauſe, that *the Wicked are cruel.* What leſs then can be inferr'd from this Place, than that Cruelty may be exercis'd towards Beaſts, which, were they meer Machines, it could not be? To which I do not ſee what can be anſwer'd, but that the Scripture accommodates itſelf to the common, tho' falſe, Opinion of Mankind, who take theſe Animals to be endued with Senſe of Pain, and think that Cruelty may be exercis'd towards them; tho', in reality, there is no ſuch thing: Beſides, having the ſame Members and Organs of Senſe as we have, it is very probable they have the ſame Senſations and Perceptions with us. To this *Des Cartes* anſwers, or indeed ſaith, he hath nothing to anſwer; but that if they think as well as we, they have an immortal Soul as well as we: Which is not at all likely, becauſe there is no Reaſon to believe it of ſome Animals without believing it of all; whereas there are many too imperfect to believe it of them, ſuch as are *Oyſters*, and *Sponges*, and the like. To which I anſwer, That there is no Neceſſity they ſhould be immortal, becauſe it is poſſible they may be deſtroy'd, or annihilated. But I ſhall not wade further into this Controverſie, becauſe it is beſide my Scope, and there hath been as much written of it already, as I have to ſay, by Dr. *Moore*, Dr. *Cudworth*, *Des Cartes*, Dr. *Willis*, and others, *Pro* and *Con.*

Of the Viſible Works of God, and their Diviſion.

I come now to take a View of the Works of the Creation, and to obſerve ſomething of the Wiſdom of God diſcernable in the Formation of them, in their Order and Harmony, and in their Ends and Uſes: And firſt, I ſhall run them over ſlightly, remarking chiefly what is obvious and expos'd to the Eyes and Notice of the more careleſs and incurious Obſerver. Secondly, I ſhall ſelect one or two particular Pieces, and take a more exact Survey of them; tho' even in theſe, more will eſcape our Notice than can be diſcover'd by the moſt diligent Scrutiny; for our Eyes and Senſes, however arm'd or aſſiſted, are too groſs to diſcern the Curioſity of the Workmanſhip of Nature, or thoſe minute Parts by which it acts, and of which Bodies are compos'd; and our Underſtanding too dark and infirm to diſcover and comprehend all the Ends and Uſes to which the infinitely wiſe Creator did deſign them.

But before I proceed, being put in Mind thereof by the mention of the Aſſiſtance of our Eyes, I cannot omit one general Obſervation concerning the Curioſity of the Works of Nature

ture in Compariſon of the Works of Art, which I ſhall propoſe in the late Biſhop of *Cheſter*'s Words, (*Treatiſe of Natural Religion*, Lib. 1. c. 6.) "The "Obſervations which have been made in theſe "latter Times by the Help of the *Microſcope*, "ſince we had the Uſe and Improvement of it, "diſcover a vaſt Difference between Natural "and Artificial Things. Whatever is Natural, "beheld thro' that, appears exquiſitely form'd, "and adorn'd with all imaginable Elegancy "and Beauty. There are ſuch inimitable Gi"dings in the ſmalleſt Seeds of Plants, but "eſpecially in the Parts of Animals, in the "Head, or Eye, of a ſmall Fly; ſuch Accu"racy, Order and Symmetry in the Frame of "the utmoſt minute Creatures, a *Louſe*, for Ex"ample, or a *Mite*, as no Man were able to con"ceive without ſeeing of them. Whereas the "moſt curious Works of Art, the ſharpeſt and "fineſt Needle, doth appear as a blunt rough "Bar of Iron, coming from the Furnace, or the "Forge: The moſt accurate Engravings, or Em"boſments, ſeem ſuch rude, bungling, and de"form'd Work, as if they had been done with a "Mattock, or Trowel; ſo vaſt a Difference is "there betwixt the Skill of Nature, and the "Rudeneſs and Imperfection of Art. I might "add, that the Works of Nature, the better "Lights and Glaſſes you uſe, the more clearer "and exactly form'd they appear; whereas the "Effects of humane Art, the more curiouſly they "are view'd and examin'd, the more of Defor"mity they diſcover."

This being premiſed, for our more clear and diſtinct Proceeding in our curſory View of the Creation, I ſhall rank the Parts of this material and viſible World under ſeveral Heads. Bodies are either *inanimate* or *animate*. *Inanimate* Bodies are either *cæleſtial* or *terreſtrial*. *Cæleſtial*, as the *Sun*, *Moon* and *Stars*; *Terreſtrial*, are either *ſimple*, as the four Elements, *Fire*, *Water*, *Earth* and *Air*; or *mixt*, either *imperfectly*, as the *Meteors*, or more perfectly, as *Stones*, *Metals*, *Minerals*, and the like. *Animate* Bodies are either ſuch as are endued with a *Vegitative* Soul, as *Plants*; or a *Senſitive* Soul, as the Bodies of *Animals*, *Birds*, *Beaſts*, *Fiſhes*, and *Inſects*; or a *Rational* Soul, as the Body of *Man*, and the Vehicles of *Angels*, if any ſuch there be.

I make uſe of this Diviſion to comply with the common and receiv'd Opinion, and for eaſier Comprehenſion and Memory; tho' I do not think it agreable to Philoſophick Verity and Accuracy, but do rather incline to the *Atomick Hypotheſis*: For theſe Bodies, we call *Elements*, are only the Ingredients of mix'd Bodies; neither are they abſolutely ſimple themſelves, as they do exiſt in the World, the Sea-water containing a copious Salt manifeſt to Senſe; and both Sea and Freſh-water ſufficing to nouriſh many Species of Fiſh, and conſequently containing the various Parts of which their Bodies are compounded. And I believe there are many Species of Bodies which the *Peripateticks* call mix'd, which are as ſimple as the *Elements* themſelves, as *Metals*, *Salts*, and ſome Sorts of

Stones. I ſhould therefore, with Dr. *Grew*, and others, rather attribute the various Species of inanimate Bodies to the divers Figures of the minute Particles of which they are made up: And the Reaſon why there is a Set, and conſtant Number, of them in the World, none deſtroy'd, nor any new ones produc'd, I take to be, becauſe the Sum of the Figures of thoſe minute Bodies into which Matter was at firſt divided, is determinate and fix'd. 2. Becauſe thoſe minute Parts are indiviſible, not abſolutely, but by any natural Force; ſo that there neither is, nor can be, more or fewer of them: For were they diviſible into ſmall and diverſly-figur'd Parts by Fire, or any other natural Agent, the Species of Nature muſt be confounded, ſome might be loſt and deſtroy'd, but new ones would certainly be produc'd; unleſs we could ſuppoſe theſe new diminutive Particles ſhould again aſſemble and marſhal themſelves into Corpuſcles of ſuch Figures as they compounded before; which I ſee no Poſſibility for them to do, without ſome Θεὸς ἀπὸ μηχανῆς to direct them: Not that I think theſe inanimate Bodies to conſiſt wholly of one Sort of *Atoms*, but that their Bulk conſiſts mainly or chiefly of one Sort. But whereas it may be objected, that Metals (which of all others ſeem to be moſt ſimple) may be tranſmuted one into another, and ſo the *Species* doth not depend upon the being compounded of *Atoms* of one Figure; I anſwer, I am not fully ſatisfied of the Matter of Fact: But if any ſuch Tranſmutation be, poſſibly all Metals may be of one

Species, and the Diverſity may proceed from the Admixture of different Bodies with the Principles of the Metal. If it be ask'd, Why may not Atoms of different Species concur to the Compoſition of Bodies? And ſo, tho' there be but a few Sorts of original Principles, may there not be produced infinite Species of compound Bodies, as by the various Diſpoſitions and Combinations of Twenty-four Letters innumerable Words may be made up? I anſwer, Becauſe the Heterogeneous Atoms or Principles are not naturally apt to cohere and ſtick together when they are mingled in the ſame Liquor, as the Homogeneous readily do.

I do not believe that the *Species* of Principles, or indiviſible Particles, are exceeding numerous; but poſſibly the immediate component Particles of the Bodies of Plants and Animals may be themſelves compounded.

Of the Heavenly Bodies.

Before I come to treat of the Heavenly Bodies in particular, I ſhall premiſe in general, that the whole Univerſe is divided into two Sorts of Bodies, the one very thin and fluid, the other more denſe, ſolid and conſiſtent. The thin and fluid is the *Ether*, comprehending the Air or Atmoſphere encompaſſing the particular Stars and Planets. Now, for the Stability and Perpetuity of the whole Univerſe, the Divine Wiſdom and Providence hath given to the ſolid and ſtable Parts a two-fold Power, one of Gravity, and the other of Circular Motion. By the firſt they are preſerv'd from Diſſolution and Diſſipation, which the ſecond would otherwiſe infer: For it being by the Conſent of Philoſophers, an innate Property of every Body mov'd circularly about any Centre to recede, or indeavour to recede, from that Centre of its Motion, and the more ſtrongly the ſwifter it is mov'd, the Stars and Planets being whirl'd about with great Velocity, would ſuddenly, did nothing inhibit it, at leaſt in a ſhort Time, be ſhatter'd in Pieces, and ſcatter'd every Way thro' the *Ether*. But now their Gravity unites and binds them up faſt, hindring the Diſperſion of their Parts. I will not diſpute what Gravity is; only I will add, that, for ought I have heard, or read, the Mechanical Philoſophers have not as yet given a clear and ſatisfactory Account of it.

The ſecond Thing is a Circular Motion upon their own *Axes*, and in ſome of them alſo, it's probable, about other Points, if we admit the *Hypotheſis* of every fix'd Star's being a Sun or Sun-like Body, and having a Choir of Planets in like Manner moving about him. Theſe Revolutions, we have Reaſon to believe, are as exactly equal and uniform as the Earth's are; which could not be, were there any Place for Chance, and did not a Providence continually over-ſee and ſecure them from all Alteration or Imminuation, which either internal Changes in their own Parts, or external Accidents and Occurrences, would at one Time or other neceſſarily induce. Without this circular Motion of the Earth, here could be no living: One Hemiſphere would be condemn'd to perpetual Cold and Darkneſs, the other continually roaſted and parch'd by the Sun-beams. And it is reaſonable to think, that this circular Motion is as neceſſary to moſt other Planetary Bodies, as it is to the Earth. As for the fix'd Stars, if they be Sun-like Bodies, it is probable alſo each of them moves circularly upon its own *Axis*, as the Sun doth: But what Neceſſity there is of ſuch a Motion, for want of underſtanding the Nature of thoſe Bodies, I muſt confeſs myſelf not yet to comprehend; tho' that it is very great, I doubt not, both for themſelves, and for the Bodies about them.

Firſt, For the Celeſtial, or Heavenly Bodies, the Equability and Conſtancy of their Motions, the Certainty of their Periods and Revolutions, the Conveniency of their Order and Situations, argue them to be ordain'd and govern'd by Wiſdom and Underſtanding; yea, ſo much Wiſdom as Man cannot eaſily fathom or comprehend: For we ſee, by how much the *Hypotheſes* of Aſtronomers are more ſimple and conformable to Reaſon, by ſo much do they give a better Account of the Heavenly Motions. It is reported of *Alphonſus* King of *Arragon*, (I know not whether truly) that when he ſaw and conſider'd the many *Eccentricks*, *Epicycles*, *Epicycles* upon *Epicycles*, *Librations*, and Contrariety of Motions, which were requiſite in the old *Hypotheſis* to give an Account of the *Celeſ-*

tial Phænomena, he ſhould preſume blaſphemouſly to ſay, that the Univerſe was a bungling Piece; and that if he had been of God's Counſel, he could have directed him to have made it better. A Speech as raſh and ignorant, as daring and prophane.

For it was nothing but Ignorance of the true Proceſs of Nature, that induced the Contrivers of that *Hypotheſis* to invent ſuch abſurd Suppoſitions, and him to accept them for true, and attribute them to the great Author of the Heavenly Motions: For in the New *Hypotheſis* of the Modern Aſtronomers, we ſee moſt of thoſe Abſurdities and Irregularities rectify'd and remov'd; and I doubt not but they would all vaniſh, could we certainly diſcover the true Method and Proceſs of Nature in thoſe Revolutions: For ſeeing in thoſe Works of Nature which we converſe with, we conſtantly find thoſe Axioms true, *Natura non facit circuitus*, Nature doth not fetch a Compaſs when it may proceed in a ſtreight Line; and *Natura nec abundat in ſuperfluis, nec deficit in neceſſariis*, Nature abounds not in what is ſuperfluous, neither is deficient in what is neceſſary. We may alſo rationally conclude concerning the Heavenly Bodies, ſeeing there is ſo much Exactneſs obſerv'd in the Time of their Motions, that they punctually come about in the ſame Periods to the Hundredth Part of a Minute, as may, beyond Exception, be demonſtrated by comparing their Revolutions; ſurely, there is alſo us'd the moſt ſimple, facile, and convenient Way for the Performance of them. Among theſe Heavenly Bodies,

Firſt, the *Sun*, a vaſt Globe of Fire, eſteem'd by the ancienter and moſt modeſt Computation above 160 Times bigger than the Earth; the very Life of this inferiour World, without whoſe ſalutary and vivifick Beams all Motion, both Animal, Vital and Natural, would ſpeedily ceaſe, and nothing be left here below but Darkneſs and Death. All Plants and Animals muſt needs in a very ſhort Time be not only mortified, but, together with the Surface of Land and Water, frozen as hard as a Flint or Adamant: So that of all the Creatures of the World, the ancient Heathen had moſt Reaſon to worſhip him as a God, tho' no true Reaſon; becauſe he was but a Creature, and not God: And we Chriſtians, to think, that the Service of the Animals that live upon the Earth, and principally Man, was one End of his Creation; ſeeing without him there could no ſuch Things have been. This *Sun*, I ſay, according to the old *Hypotheſis*, whirl'd round about the Earth daily with incredible Celerity, making Night and Day by his riſing and ſetting; Winter and Summer, by his Acceſs to the ſeveral Tropicks, creating ſuch a grateful Variety of Seaſons, enlightning all Parts of the Earth by his Beams, and cheriſhing them by his Heat, ſituate and mov'd ſo in Reſpect of this ſublunary World, (and it's likely alſo in Reſpect of all the Planets about him) that Art and Council could not have deſign'd either to have placed him better, or mov'd him more conveniently for the Service thereof, as I could eaſily make appear by the Inconveniences that would follow upon the Suppoſition of any other Situation and Motion, ſhews forth the great Wiſdom of him who ſo diſpos'd and mov'd him.

Secondly, The *Moon*, a Body in all Probability ſomewhat like the Earth we live upon, by its conſtant and regular Motion, helps us to divide our Time, reflects the Sun-beams to us, and ſo by illuminating the Air, takes away in ſome Meaſure the diſconſolate Darkneſs of our Winter-Nights; procures, or at leaſt regulates, the Fluxes and Refluxes of the Sea, whereby the Water is kept in conſtant Motion, and preſerv'd from Putrefaction, and ſo render'd more ſalutary for the Maintenance of its Breed, and uſeful and ſerviceable for Man's Convenience of Fiſhing and Navigation; not to mention the great Influence it is ſuppos'd to have upon all moiſt Bodies, and the Growth and Increaſe of Vegetables and Animals: Men generally obſerving the Age of the *Moon* in the planting of all Kinds of Trees, ſowing of Grain, grafting and inocculating, and pruning of Fruit-Trees, gathering of Fruit, cutting of Corn or Graſs; and thence alſo making Prognoſticks of Weather, becauſe ſuch Obſervations ſeem to me uncertain. Did this *Luminary* ſerve to no other Ends and Uſes, as I am perſuaded it doth many, eſpecially to maintain the Creatures which in all likelihood breed and inhabit there, for which I refer you to the ingenious Treatiſes written by Biſhop *Wilkins*, and

Monſieur *Fontenelle*, on that Subject; yet theſe were enough to evince it to be the Effect and Product of Divine Wiſdom and Power.

Thirdly, As for the reſt of the *Planets*, beſides their particular Uſes, which are to us unknown, or meerly conjectural, their Courſes and Revolutions, their Stations and Retrogradations, obſerv'd conſtantly ſo many Ages together in moſt certain and determinate Periods of Time, do ſufficiently demonſtrate, that their Motions are inſtituted and govern'd by Counſel, Wiſdom and Underſtanding.

Fourthly, The like may be ſaid of the *fix'd Stars*, whoſe Motions are regular, equal and conſtant: So that we ſee nothing in the Heavens which argues Chance, Vanity, or Error; but, on the contrary, Rule, Order, and Conſtancy; the Effects and Arguments of Wiſdom: Wherefore, as *Cicero* excellently concludes, *Cæleſtem ergo admirabilem ordinem, incredibilemque conſtantiam, ex qua converſatio & ſalus omnium omnis oritur, qui vacare mente putat, næ ipſe mentis expers habendus eſt:* "Wherefore whoſoever thinketh that the admirable Order, and incredible Conſtancy, of the Heavenly Bodies, and their Motions, whereupon the Preſervation and Welfare of all Things doth depend, is not govern'd by Mind and Underſtanding, he himſelf is to be accounted void thereof." And again, "Shall we (ſaith he) when we ſee an Artificial Engine, as a Sphere or Dyal, or the like, at firſt Sight acknowledge, that it is a Work of Reaſon and Art? *Cum autem impe-*

tum cœli, admirabili cum celeritate moveri vertique videamus conſtantiſſimè conficientem viciſſitudines anniverſarias, cum ſummâ Salute & Conſervatione rerum omnium, dubitare quin ea non ſolum ratione fiant, ſed excellenti quâdam Divinâque ratione: "And can we, when we ſee the "Force of the Heavens mov'd and whirl'd about "with admirable Celerity, moſt conſtantly "finiſhing its anniverſary Viciſſitudes, to the "eminent Welfare and Preſervation of all "Things, doubt at all that theſe Things are "perform'd not only by Reaſon, but by a cer"tain excellent and divine Reaſon?

To theſe Things I ſhall add an Obſervation, which I muſt confeſs myſelf to have borrow'd of the honourable Perſon more than once mention'd already, that even the *Eclipſes* of the *Sun* and *Moon*, though they be frightful Things to the Superſtitious Vulgar, and of ill Influence on Mankind, if we may believe the no leſs ſuperſtitious Aſtrologers, yet to knowing Men, that can skilfully apply them, they are of great Uſe, and ſuch as common Heads could never have imagin'd: Since not only they may, on divers Occaſions, help to ſettle *Chronology*, and rectifie the Miſtakes of *Hiſtorians* that writ many Ages ago; but which is, though a leſs Wonder, yet of greater Utility, they are (as Things yet ſtand) neceſſary to difine with competent Certainty, the Longitude of Places or Points on the Terraqueous Globe, which is a Thing of very great Moment not only to *Geography*, but to the moſt uſeful and important Art of *Navigation.* To which may be added, which I ſhall hereafter mention, that they ſerve to demonſtrate the ſpherical Roundneſs of the Earth: So that I may well conclude with the Pſalmiſt, *Pſal.* xix. 1. *The Heavens declare the Glory of God, and the Firmament ſheweth his Handy-work.*

Of Terreſtrial and Inanimate Simple Bodies.

I come now to conſider the Terreſtrial Bodies. I ſhall ſay nothing of the whole Body of the Earth in general, becauſe I reſerve that as one of the Particulars I ſhall more carefully and curiouſly examine.

Terreſtrial Bodies, according to our Method before propounded, are either *inanimate*, or *animate*, and the *inanimate* either *ſimple*, or *mixt*; *Simple*, as the four Elements, *Fire*, *Water*, *Earth* and *Air*: I call theſe *Elements* in Compliance (as I ſaid before) with the vulgarly-receiv'd Opinion; not that I think them to be the Principles or component Ingredients of all other ſublunary Bodies: I might call them the four great Aggregates of Bodies of the ſame Species, or four Sorts of Bodies, of which there are great Aggregates. Theſe, notwithſtanding they are endued with contrary Qualities, and are continually encroaching one upon another, yet they are ſo balanc'd, and kept in ſuch an *Equilibrium*, that neither prevaileth over other, but what one gets in one Place it loſeth in another.

Firſt, *Fire* cheriſheth and reviveth by its Heat, without which all Things would be torpid, and without Motion, nay, without Fire, no Life, it being the vital Flame reſiding in the Blood that keeps the bodily Machine in Motion, and renders it a fit Organ for the Soul to work by. The Uſes of Fire (I do not here ſpeak of the Peripateticks Elementary Fire in the Concave of the Moon, which is but a meer Figment, but our ordinary Culinary) are in a Manner infinite for dreſſing and preparing of Victuals, bak'd, boil'd and roſt; for melting and refining of Metals and Minerals; for the Fuſion of Glaſs, [a Material whoſe Uſes are ſo many, that it is not eaſie to enumerate them, it ſerving us to make Windows for our Houſes, Drinking Veſſels, Veſſels to diſtil and preſerve all Sorts of fermented Liquors, diſtill'd Water, Spirits, Oils, Extracts, and other Chymical Preparations, as alſo Veſſels to diſtil and prepare them in; for Looking-Glaſſes, Spectacles, Microſcopes and Teleſcopes, whereby our Sight is not only reliev'd, but wonderfully aſſiſted to make rare Diſcoveries] for making all Sorts of Inſtruments for Husbandry, mechanick Arts and Trades, all Sorts of Arms or Weapons of War defenſive and offenſive; for fulminating Engines; for burning of Lime, baking of Bricks, Tiles, and all Sorts of Potters Veſſels, or Earthen Ware; for caſting and forging Metaline Veſſels and Utenſils; for Diſtillations, and all Chymical Operations hinted before in the Uſe of Glaſs; for affording us Lights for any Work or Exerciſe in Winter-Nights; for digging in Mines and dark Caverns; and, finally, by its comfortable Warmth ſecuring us from the Injuries of Cold, or relieving us when we have been bitten and benum'd with it. A Subject or Utenſil of ſo various and inexplicable Uſe, who could have invented and formed, but an infinitely wiſe and powerful Efficient?

Secondly, The *Air* ſerves us, and all Animals, to breath in, containing the Fewel of that vital Flame we ſpeak of, without which it would ſpeedily languiſh and go out; ſo neceſſary it is for us, and other Land-Animals, that without the Uſe of it we could live but very few Minutes: Nay, Fiſhes, and other Water-Animals, cannot abide without the Uſe of it; for if you put Fiſh into a Veſſel of a narrow Mouth full of Water, they will live and ſwim there, not only Days and Months, but even Years; but if with your Hand, or any other Cover, you ſtop the Veſſel ſo as wholly to exclude the Air, or interrupt its Communication with the Water, they will ſuddenly be ſuffocated; as *Rondeletius* affirms he often experimented. If you fill not the Veſſel up to the Top, but leave ſome Space empty for the Air to take up, and then clap your Hand upon the Mouth of the Veſſel, the Fiſhes will preſently contend which ſhall get uppermoſt in the Water, that ſo they may enjoy the open Air; which I have alſo obſerv'd them to do in a Pool of Water that hath been almoſt dry in the Summer-Time, becauſe the Air that inſinuated itſelf into the Water did not ſuffice them for Reſpiration. Neither is it leſs neceſſary for Inſects than it is for other Animals, but rather more, theſe having more Air-Veſſels for their Bulk by far than they, there being many Orifices on each Side their Bodies for the Admiſſion of Air, which if you ſtop with Oil or Honey, the Inſect preſently dies, and revives no more. This was an Obſervation of the Ancients, though the Reaſon of it they did not underſtand; (*Oleo illito Inſecta omnia exanimantur.* Plin.) which was nothing but the intercluding of the Air; for tho' you put Oil upon them, if you put it not upon, or obſtruct thoſe Orifices therewith, whereby they draw the Air, they ſuffer nothing: If you obſtruct only ſome, and not others, the Parts which are near and ſupplied with Air, from thence are by and by convulſed, and ſhortly relaxed and deprived of Motion, the reſt that were untouch'd ſtill retaining it. Nay, more than all this, Plants themſelves have a Kind of Reſpiration, being furniſh'd with Plenty of Veſſels for the Derivation of Air to all their Parts; as hath been obſerv'd, nay, firſt diſcover'd, by that great and curious Naturaliſt *Malpighius.* Another Uſe of the Air is to ſuſtain the Flight of Birds and Inſects. Moreover, by its Gravity its raiſes the Water in Pumps, Siphons, and other Engines, and performs all thoſe Feats which former Philoſophers, through Ignorance of the Efficient Cauſe, attributed to a Final, namely, Nature's Abhorrence of a Vacuity or empty Space. The elaſtick or expanſive Faculty of the Air, whereby it dilates itſelf, when compreſſed, (indeed this lower Region of it, by Reaſon of the Weight of the Superincumbent, is always in a compreſſed State) hath been made Uſe of in the common Weather-Glaſſes, in Wind-Guns, and in ſeveral ingenious Water-Works, and doubtleſs hath a great Intereſt in many natural Effects and Operations.

Againſt what we have ſaid of the Neceſſity of the Air for the Maintenance of the Vital Flame, it may be objected, That the *Fœtus* in the Womb lives, its Heart pulſes, and its Blood circulates; and yet it draws in no Air, neither hath the Air any Acceſs to it. To which I anſwer, That it doth receive Air, ſo much as is ſufficient for it in its preſent State, from the maternal Blood by the *Placenta Uterina*, or the *Cotyledons*. This Opinion generally propounded, *viz.* That the Reſpiration of the Dam did ſerve the *Fœtus* alſo, or ſupply ſufficient Air to it, I have met with in Books; but the explicit Notion of it I owe to my Learned and Worthy Friend Dr. *Edward Hulſe*, which, comparing with mine own Anatomical Obſervations, I found ſo conſonant to Reaſon, and highly probable, that I could not but yield a firm Aſſent to it. I ſay then, That the chief Uſe of the Circulation of the Blood through the *Cotyledons* of a Calf in the Womb, (which I have often diſſected) and by Analogy thro' the *Placenta Uterina* in an Humane *Fœtus*, ſeems to be the Impregnation of the Blood with Air, for the Feeding of the *Vital Flame*: For if it were only for Nutrition, what Need of two ſuch great Arteries to convey the Blood thither? It would (one might rationally think) be more likely, that as in the *Abdomen* of every Animal, ſo here, there ſhould have been ſome lacteal Veins form'd, beginning from the *Placenta*, or *Cotyledons*, which concurring in one common *Ductus*, ſhould at laſt empty themſelves into the *Vena Cava*. Secondly, I have obſerved in a Calf, the Umbilical Veſſels to terminate in certain Bodies divided into a Multitude of carneous *Papillæ*, (as I may ſo call them) which are receiv'd into ſo many Sockets of the *Cotyledons* growing on the Womb; which carneous *Papillæ* may without Force, or Laceration, be drawn out of thoſe Sockets. Now theſe *Papillæ* do well reſemble the *Ariſtæ*, or *Radii*, of a Fiſh's Gills, and very probably have the ſame Uſe to take in the Air; ſo that the maternal Blood which flows to the *Cotyledons*, and encircles theſe *Papillæ*, communicates by them to the Blood of the *Fœtus*, the Air wherewith itſelf is impregnate; as the Water flowing about the carneous *Radii* of the Fiſh's Gills doth the Air that is lodg'd therein to them. Thirdly, That the maternal Blood flows moſt copiouſly to the *Placenta Uterina* in Women, is manifeſt from the great Hemorrhagy that ſucceeds the Separation thereof at the Birth. Fourthly, After the Stomach and Inteſtines are form'd, the *Fœtus* ſeems to take in its whole Nouriſhment by the Mouth, there being always found in the Stomach of a Calf, Plenty of the Liquor contain'd in the *Amnios* wherein he ſwims, and *Fæces* in his Inteſtines, and abundance of Urine in the *Allantoides*; ſo that the *Fœtus* in the Womb doth live, as it were, the Life of a Fiſh. Laſtly, Why elſe ſhould there be ſuch an inſtant Neceſſity of Reſpiration ſo ſoon as ever the *Fœtus* is fallen off from the Womb.

I know that if the *Fœtus* be taken out of the Womb incloſ'd in the Secundines, it will continue to live, and the Blood to circulate for a conſiderable Time, as Dr. *Harvey* obſerves. The Reaſon whereof I conceive to be, becauſe the Blood ſtill circulates through the *Cotyledons*, or *Placenta*, which are now expoſ'd to the open Air, and ſo from thence receives ſufficient Supplies thereof, to continue its gentle Motion, and feed the Vital Flame. But when, upon Excluſion of the Young, the Umbilical Veſſels are broken, and no more Air is receiv'd that Way, the Plaſtick Nature, to preſerve the Life of the Animal, ſpeedily raiſes the Lungs, and draws into them Air in great abundance, which cauſes a ſudden and mighty Accenſion in the Blood, to the Maintenance whereof a far greater Quantity of Air is requiſite, than would ſerve to feed the mild and languid Flame before.

This Way we may give a facile and very probable Account of it, to wit, becauſe receiving no more Communications of Air from its Dam, or Mother, it muſt needs have a ſpeedy Supply from without, or elſe extinguiſh and die for Want of it; being not able to live longer without Air at its firſt Birth, than it can do afterward.

Upon this Occaſion, give me leave to diſcourſe a little concerning the Air's inſinuating itſelf into the Water. I ſay therefore, That the Air, at leaſt that Part of it which is the Aliment of Fire, and Fewel of the Vital Flame in Animals, eaſily penetrates the Body of Water expos'd to it, and diffuſeth itſelf through every Part of it. Hence it is that we find Fiſh in ſubterraneous Rivers, and foſſil Fiſh in the Earth itſelf; which can no more live without Air there than in the open Waters: Hence the Miners, when they come once at Water, are out of all Danger of Damps. You'll ſay, How gets the Air into the Water in Subterraneous Rivers, and into the Earth to the foſſil Fiſhes? I anſwer, The ſame Way that the Water doth: Which I ſuppoſe to be by its upper Superficies; the Water deſcending by Pores and Paſſages, that there it finds into Chinks and Veins, and by Confluence of many of them by Degrees ſwelling into a Stream, the Air accompanies and follows it by a conſtant Succeſſion. As for foſſil Fiſhes, ſome make their Way into the Earth up the Veins of Water opening into the Banks of Rivers, where they lie till they grow ſo great that they cannot return: In which Veins they find Air enough to ſerve their Turn, needing not much by Reaſon that they lie ſtill, and move but little. Others in Times of Floods are left in the Meadows, and with the Water ſink into the Earth at ſome Holes and Pores that the Water finds, or makes, by which alſo they are ſupplied with Air. The Reaſon why the Miners are out of Danger of Damps when they come to Water, I conceive is, becauſe then preſently the Air that ſtagnated in the Shaft ſinks into the Water, and freſh Air deſcends and ſucceeds, and ſo there is a Circulation; in the ſame Manner as by the ſinking of an Air-Shaft the Air hath Liberty to circulate, and carry out the Steams both of the Miners Breath and the Damps, which would otherwiſe ſtagnate there. Indeed, though there were no Damps, yet the nitrous Part of the Air being ſpent and conſum'd by the Breathing of the Miners, the remaining Part would be render'd altogether unfit for Reſpiration, unleſs new and freſh Air could ſucceed.

And here, methinks, appears a Neceſſity of bringing in the Agency of ſome Super-intendent intelligent Being, be it a *Plaſtick Nature*, or what you will: For what elſe ſhould put the Diaphragm, and all the Muſcles ſerving to Reſpiration, in Motion all of a ſudden ſo ſoon as ever the *Fœtus* is brought forth? Why could they not have reſted as well as they did in the Womb? What aileth them that they muſt needs beſtir themſelves to get in Air to maintain the Creature's Life? Why could they not patiently ſuffer it to die? That the Air of itſelf could not ruſh in, is clear; for that, on the contrary, there is requir'd ſome Force to remove the incumbent Air, and make room for the External to enter. You will ſay, the Spirits do at this

Time flow to the Organs of Reſpiration, the Diaphragm, and other Muſcles which concur to that Action, and move them. But what rouſes the Spirits, which were quieſcent during the Continuance of the *Fœtus* in the Womb? Here is no appearing Impellent but the External Air, the Body ſuffering no Change but of Place, out of its cloſe and warm Priſon into the open and cool Air: But how, or why, that ſhould have ſuch an Influence upon the Spirits, as to drive them into thoſe Muſcles electively, I am not ſubtil enough to diſcern. As for the Reſpiration of the Chick in the Egg, I ſuppoſe the Air not only to be included in the White, but alſo to be ſupply'd through the Shell and Membranes.

Thirdly, *Water* is one Part, and that not the leaſt of our Suſtenance, and that affords the greateſt Share of Matter in all Productions; being not (as it exiſts in the World) a ſimple and unmix'd Body, but containing in it the Principles, or minute component Particles of all Bodies: To ſpeak nothing of thoſe inferiour Uſes of Waſhing and Bathing, dreſſing and preparing Victuals. But if we ſhall conſider the great *Concepticula* and Congregations of Water, and the Diſtribution of it all over the dry Land in Springs and Rivers, there will occur abundant Arguments of Wiſdom and Underſtanding. The Sea, what infinite Variety of Fiſhes doth it nouriſh! *Pſal.* civ. 25. In the Verſe next to my Text, *The Earth is full of thy Riches; So is this great and wide Sea, wherein are Things* *creeping innumerable, both ſmall and great Beaſts,* &c. How doth it exactly compoſe itſelf to a Level, or equal Superficies, and with the Earth make up one Spherical Roundneſs? How doth it conſtantly obſerve its Ebbs and Flows, its Spring and Nepe-Tides, and ſtill retain its Saltneſs, ſo convenient for the Maintenance of its Inhabitants, ſerving alſo the Uſes of Man for Navigation, and the Convenience of Carriage? That it ſhould be defined by Shores, and Strands, and Limits, I mean at firſt, when it was natural to it to overflow and ſtand above the Earth. All theſe Particulars declare abundance of Wiſdom in their Primitive Conſtitution. This laſt the Pſalmiſt takes Notice of in the 6th, 7th, 8th, and 9th Verſes of this *Pſalm*: Speaking of the Earth at the firſt Creation, he ſaith, *Thou covered'ſt it with the Deep as with a Garment, the Waters ſtood above the Mountains: At thy Rebuke they fled, at the Voice of thy Thunder they haſted away* (*the Mountains aſcend, the Valleys deſcend*) *unto the Place thou haſt prepared for them. Thou haſt ſet a Bound that they may not paſs over: That they turn not again to cover the Earth.* But what Need was there (may ſome ſay) that the Sea ſhould be made ſo large, that its *Superficies* ſhould equal, if not exceed, that of the dry Land? Where is the Wiſdom of the Creator in making ſo much uſeleſs Sea, and ſo little dry Land, which would have been far more beneficial and ſerviceable to Mankind? Might not at leaſt half the Sea have been ſpar'd, and added to the Land, for the Entertainment and Maintenance of Men, who by their continual Striving and Fighting to enlarge their Bounds, and encroaching upon one another, ſeems to be ſtraitned for want of Room.

To this Objection againſt the Wiſdom of God in thus dividing *Sea* and *Land*, Mr. *Keill*, in his *Examination of Dr.* Burnet's *Theory of the Earth*, p. 92, 93. thus anſwers: *This, as moſt other of the Atheiſts Arguments, proceeds from a deep Ignorance of Natural Philoſophy; for if there were but half the Sea that now is, there would be alſo but half the Quantity of Vapours, and conſequently we could have but half ſo many Rivers as now there are to ſupply all the dry Land we have at preſent, and half as much more; for the Quantity of Vapours which are rais'd, bears a Proportion to the Surface whence they are rais'd, as well as to the Heat which rais'd them. The Wiſe Creator therefore did ſo prudently order it, that the Sea ſhould be large enough to ſupply Vapours ſufficient for all the Land, which it would not do if it were leſs than now it is.*

But againſt this it may be objected, Why ſhould not all the Vapours which are rais'd out of the Sea fall down again into it by Rain? Is there not as much Reaſon that the Vapours which are exhaled out of the Earth ſhould be carried down to the Sea, as that thoſe raiſed out of the Sea be brought up upon the dry Land? If ſome by Winds be driven from the Sea up Land, others by the ſame Cauſe will be blown down from Land to Sea, and ſo balancing one another, they will in Sum fall equally upon Sea and Land; and conſequently the Sea contribute nothing to the Watering of the Earth, or the Maintenance of Rivers.

To which I anſwer, That as to the Watering of the Earth there needs no Supply from the Sea, there being ſufficient Water exhaled out of itſelf to do that; there is no more return'd upon it by Rain ſo as to reſt upon it, than an equivalent Quantity to what was rais'd out of it.

But the Rivers muſt be ſupply'd otherways. Our Opinion is, That they have their Supply from Rain and Vapours. The Queſtion is, Whence theſe Vapours are brought? We anſwer, From the Sea. But what brings them up from the Sea? I anſwer, The Winds: And ſo I am arriv'd at the main Difficulty. Why ſhould not the Winds carry them that are exhaled out of the *Earth* down to the *Sea*, as well as bring them up upon the Earth, which are rais'd from the Sea? Or, which is all one, why ſhould not the Winds blow indifferently from Sea and Land? To which I anſwer, That I muſt needs acknowledge myſelf not to comprehend the Reaſon hereof. God is truly ſaid, *Pſal.* cxxxv. 7. *To bring the Wind out of his Treaſures.* But the Matter of Fact is moſt certain, *viz.* That the Winds do bring abundantly more Vapours up from the Sea than they carry down thither.

Firſt, Becauſe otherwiſe there can no Account be given of *Floods.* It is clear, That Floods with us proceed from Rain; and it is often a vaſt Quantity of Water they carry down to the Sea. Whence come thoſe Vapours which ſupply all this Water? I hope thoſe who bring up Springs and Rivers from the great *Abyſs*, will not bring thoſe Vapours, which unite into Drops, and deſcend in Rain from thence too. Should they riſe from the dry Land only, they would ſoon render it dry indeed; more parch'd than the Deſarts of *Libya*. We ſhould quickly come to an End of Floods, and of Rain too, if nothing were return'd from the Sea again, not to mention, that the Sea muſt needs in ſuch a Caſe overflow its Shores, and enlarge its Bounds.

But this Way there is an eaſy Account to be given. It is clear, that the Sun doth exhale Vapours both from Sea and Land; and that the Superficies of Sea and Land is ſufficient to yield Vapours for Rain, Rivers and Floods, when heated to ſuch a Degree as the Sun heats it: So that there wants only Wind to bring up ſo great a Proportion of Vapours from the Sea as may afford Water for the Floods; that is, ſo much as is return'd back again to the Sea.

Some may perchance demand, To what Purpoſe ſerve the Floods? What Uſe is there of them? I anſwer, To return back to the Sea the Surpluſage of Water after the Earth is ſated with Rain. It may be further ask'd, What need more Rain be poured upon the Earth than is ſufficient to water it? I reply, That the Rain brings down from the Mountains and higher Grounds a great Quantity of Earth, and in Times of Floods ſpreads it upon the Meadows and Levels, rendering them thereby ſo fruitful as to ſtand in need of no Culture, or Manuring. So we ſee the Land of *Egypt* owes its great Fertility to the annual Overflowing of the River *Nilus*: And it's likely the Countries bordering upon the River of *Ganges* may receive the like Benefit by the Overflowing thereof. Moreover, all Rain-Water contains in it a copious Sediment of Terreſtrial Matter, which by ſtanding it precipitates, and is not a ſimple Elementary Water. This Terreſtrial Matter ſerves for the Nouriſhment of Plants, and not the Water itſelf, which is but a Vehicle to derive this Nutriment to all the Parts of the Plants: And therefore the more Rain, the more of this Nutricious Matter may be precipitated upon the Earth, and ſo the Earth render'd more fruitful. Beſides all this, it's not unlikely, that the Rain-Water may be endued with ſome Vegetating or Prolifick Virtue, deriv'd from ſome Saline or Oleoſe Particles it contains: For we ſee, that Aquatick Plants, which grow in the very Water, do not thrive and flouriſh in dry Summers, when they are not alſo water'd with the Dew of Heaven.

Secondly, Another Argument to prove, That the Winds bring up more Vapours from the Sea than they carry down thither, is, Becauſe the Winds do more frequently blow from the Sea than to the Sea. This appears from the Trees which grow on and near the Sea-ſhores all along the Weſtern Coaſt of *England*, whoſe Heads and Boughs I have obſerv'd to run out far to Landward; but toward the Sea to be ſo ſnub'd by the

Winds, as if their Boughs and Leaves had been pared or ſhaven off on that Side.

It is alſo obſerv'd, that the Weſtern Wind, which is the moſt violent and boiſterous of all with us in *England*, which comes from off the great *Atlantick* Ocean, is of longeſt Continuance. *Julius Cæſar*, in his 5th Book of *Commentaries de Bello Gallico*, ſaith of it, *Magnam partem omnis temporis in his locis fluere conſuevit*; it is wont to blow in theſe Quarters a great Part of the whole Year: Which Obſervation holds true at this Day, the Wind lying in that Corner at leaſt three Quarters of the Year.

Since this Motion of the Winds is conſtant, there is doubtleſs a conſtant and ſettled Cauſe of it, which deſerves to be enquir'd into, and ſearch'd out, by the Study and Endeavours of the moſt ſagacious Naturaliſts. But however the Wind be rais'd, it may more eaſily blow from Sea to Land, than from Land to Sea, becauſe the Superficies of the Sea being even, or level, there is nothing to ſtop its Courſe; but on the Land there are not only Woods, but Mountains to hinder and divert it.

Having myſelf ſeen ſo much of the Bottom of the Sea round about the Coaſts of *England*, and a great Part of the *Low Countries*, of *Italy* and *Sicily*, I muſt needs adhere to what I deliver'd, That where the Bottom of the Sea is not Rocky, but Earth, Owze, or Sand, and that is incomparably the greateſt Part of it, it is by the Motion of the Waters, ſo far as the Reciprocation of the Sea extends to the Bottom, brought to a Level; and if it ſhould be now unequal, would in Time be level'd again. By Level I do not mean ſo as to have no Declivity (for the Reciprocation preſerves that, the Flood hindering the conſtant carrying down of the Bottom) but only to have an equal and uniform Deſcent from the Shores to the Deeps. Now all thoſe Relations of Urinators belong only to thoſe Places where they have dived, which are always rocky; for there is no Reaſon why they ſhould dive where the Bottom is level and ſandy. That the Motion of the Water deſcends to a good Depth, I prove from thoſe Plants that grow deepeſt in the Sea, becauſe they all generally grow flat, in Manner of a Fan, and not with Branches on all Sides like Trees, which is ſo contriv'd by the Providence of Nature; for that the Edges of them do in that Poſture with moſt Eaſe cut the Water flowing to and fro; and ſhould the flat Side be objected to the Stream, it would ſoon be turn'd Edge-wiſe by the Force of it, becauſe in that Site it doth leaſt reſiſt the Motion of the Water: Whereas, did the Branches of theſe Plants grow round, they would be thrown backward and forward every Tide. Nay, not only the Herbaceous and Woody Submarine Plants, but alſo the * *Lithophyta* themſelves affect this Manner of growing, as I have obſerv'd in various Kinds of *Corals* and *Pori*. Hence I ſuſpect all thoſe Relations concerning Trees growing at the Bottom of the Sea, and bringing forth Fruit there: And as for the *Maldiva Nut*, till better Information, I adhere

* Stone-Plants.

to *Garcias*'s Opinion, which may be ſeen in *Cluſius*. Farther I do believe, that in the great Depths of the Sea there grow no Plants at all, the Bottom being too remote from the External Air, which though it may pierce the Water ſo low, yet I doubt whether in Quantity ſufficient for the Vegetation of Plants: Nay, we are told, That in thoſe deep and bottomleſs Seas there are no Fiſh at all; yet, not becauſe there are no Plants, or Inſects, to feed them, for that they can live upon Water alone, *Rondeletius*'s Experiment about keeping them in a Glaſs doth undeniably prove, but becauſe their Spawn would be loſt in thoſe *Seas*, the Bottom being too cold for it to quicken there; or rather becauſe being lighter than the Water there, it would not ſink to the Bottom, but be buoy'd up by it, and carried away to the Shallows.

Again, The great Uſe and Convenience, the Beauty and Variety of ſo many Springs and Fountains, ſo many Brooks and Rivers, ſo many Lakes and ſtanding Pools of Water, and theſe ſo ſcatter'd and diſpers'd all the Earth over, that no great Part of it is deſtitute of them, without which it muſt, without a Supply otherways, be deſolate and void of Inhabitants; afford abundant Arguments of Wiſdom and Council: That Springs ſhould break forth on the Sides of Mountains moſt remote from the Sea: That there ſhould Way be made for Rivers thro' Straits and Rocks, and ſubterraneous Vaults, ſo that one would think that Nature had cut a Way on Purpoſe to derive the Water, which elſe would overflow and drown whole Countries: That the Water paſſing thro' the Veins of the Earth, ſhould be rendred freſh and potable, which it cannot be by any Percolations we can make, but the ſaline Particles will paſs through a tenfold Filtre: That in ſome Places there ſhould ſpring forth Metalick and Mineral Waters, and hot Baths, and theſe ſo conſtant and permanent for many Ages; ſo convenient for divers Medicinal Intentions and Uſes, the Cauſes of which Things, or the Means and Methods by which they are perform'd, have not been as yet certainly diſcover'd; only in General, *Pliny*'s Remark may be true, *Tales ſunt aquæ, qualis terra per quam fluunt.* Hence they are Cold, Hot, Sweet, Stinking, Purgative, Diuretick, or Ferrugineous, Saline, Petrefying, Bituminoſe, Venenoſe, and of other Qualities.

Laſtly, The *Earth*, which is the Baſis and Support of all Animals and Plants, and affords them the hard and ſolid Part of their Bodies, yielding us Food and Suſtenance, and partly alſo Cloathing; for I do not think that Water ſupplies Man, and other Animals, or even Plants themſelves, with their Nouriſhment, but ſerves chiefly for a Vehicle to the Alimentary Particles, to convey and diſtribute them to the ſeveral Parts of the Body. Water, as it exiſts in the World, is not a ſimple unmix'd Body, but contains the Terreſtrial component Parts of the Bodies of Animals and Plants: Simple Elementary Water nouriſhes not at all. How variouſly is the Surface of this Earth diſtinguiſh'd into

Hills, and Valleys, and Plains, and high Mountains, affording pleaſant Proſpects? How curiouſly cloath'd and adorn'd with the grateful Verdure of Herbs and ſtately Trees, either diſpers'd and ſcatter'd ſingly, or as it were aſſembled in Woods and Groves, and all theſe beautified and illuſtrated with Elegant Flowers and Fruits, *quorum omnium incredibilis multitudo, inſatiabili varietate diſtinguitur*, as *Tully* ſaith. This alſo ſhews forth to them that conſider it, both the Power and Wiſdom of God: So that we may conclude with *Solomon*, Prov. iii. 19. *The Lord by Wiſdom hath founded the Earth, by Underſtanding hath he eſtabliſh'd the Heavens.*

But now, if we paſs from Simple to Mix'd Bodies, we ſhall ſtill find more Matter of Admiration, and Argument of Wiſdom. Of theſe we ſhall firſt conſider thoſe they call imperfectly Mix'd, or *Meteors.*

Of Meteors.

As firſt of all *Rain*, which is nothing elſe but Water, by the Heat of the Sun divided into very ſmall inviſible Parts, aſcending in the Air, till encountring the Cold, it be by Degrees condens'd into Clouds, and deſcends in Drops; this, though it be exhaled from the Salt Sea, yet by this Natural Diſtillation is render'd freſh and potable, which our Artificial Diſtillations have hitherto been hardly able to effect, notwithſtanding the Eminent Uſe it would be of to Navigators, and the Rewards promis'd to thoſe that ſhould reſolve that Problem of diſtilling freſh Water out of Salt. That the Clouds ſhould be ſo carried about by the Winds, as to be almoſt equally diſpers'd and diſtributed, no Part of the Earth wanting convenient Showers, unleſs when it pleaſeth God, for the Puniſhment of a Nation, to with-hold Rain by a ſpecial Interpoſition of his Providence, or, if any Land wants Rain, they have a Supply ſome other Way; as the Land of *Egypt*, though there ſeldom falls any Rain there, yet hath abundant Recompence made it by the annual Overflowing of the River. This Diſtribution of the Clouds and Rain is to me (I ſay) a great Argument of Providence and Divine Diſpoſition; for elſe I do not ſee but why there might be in ſome Lands continual ſucceſſive Droughts for many Years, till they were quite depopulated; in others as laſting Rains, till they were overflown and drown'd; and theſe, if the Clouds mov'd caſually, often happening; whereas, ſince the ancienteſt Records of Hiſtory, we do not read, or hear, of any ſuch Droughts, or Inundations, unleſs perhaps that of *Cyprus*, wherein there fell no Rain there for thirty ſix Years, till the Iſland was almoſt quite deſerted, in the Reign of *Conſtantine*; which doubtleſs fell not out without the wiſe Diſpoſition of Providence, for great and weighty Reaſons.

Again, If we conſider the Manner of the Rain's Deſcent, diſtilling down gradually, and by Drops, which is moſt convenient for the Watering of the Earth; whereas, if it ſhould fall down in a continual Stream like a River, it would gall the Ground, waſh away Plants by the Roots, overthrow Houſes, and greatly incommode, if not ſuffocate Animals: If, I ſay, we conſider theſe Things, and many more that might be added, we might in this Reſpect alſo cry out with the Apoſtle, *O the Depth of the Riches both of the Wiſdom and Knowledge of God!*

Secondly, Another Meteor is the *Wind*; which how many Uſes it doth ſerve to, is not eaſie to enumerate, but many it doth, *viz.* to ventilate and break the Air, and diſſipate noiſom and contagious Vapours, which otherwiſe ſtagnating, might occaſion many Diſeaſes in Animals; and therefore it is an Obſervation concerning our Native Country, *Anglia ventoſa, ſi non ventoſa, venenoſa*: To transfer the Clouds from Place to Place, for the more commodious Watering of the Earth: To temper the Exceſſes of the Heat, as they find, who, in *Braſil*, *New Spain*, the Neighbouring Iſlands, and other the like Countries near the Equator, reap the Benefit of the Breezes: To fill the Sails of Ships, and carry them on their Voyages to remote Countries; which, of what eminent Advantage it is to Mankind, for the procuring and continuing of Trade and mutual Commerce between the moſt diſtant Nations, the illuſtrating every Corner of the Earth, and the perfecting Geography and Natural Hiſtory, is apparent to every Man. That the Monſoons and Trade-winds ſhould be ſo conſtant and periodical even to the 30th Degree of Latitude all round the Globe, and that they ſhould ſo ſeldom tranſgreſs or fall ſhort of thoſe Bounds, is a Subject worthy of the Thoughts of the greateſt Philoſophers. To this may be added the driving about of Wind-Mills for grinding of Corn, making of Oil, draining of Pools, raiſing of Water, ſawing of Wood, fulling of Cloth, *&c.* That it ſhould ſeldom or never be ſo violent and boiſterous, as to overturn Houſes; yea, whole Cities; to tear up Trees by the Roots, and proſtrate Woods; to drive the Sea over the lower Countries; as, were it the Effect of Chance, or mere natural Cauſes, not moderated by a ſuperiour Power, it would in all likelihood often do. Hurricanes, Spouts, and Inundations would be more frequent then they are. All theſe Things declare the Wiſdom and Goodneſs of Him *who bringeth the Wind out of his Treaſures.*

Of Inanimate Mix'd Bodies.

I proceed now to ſuch inanimate Bodies as are called *Perfectè mixta*, perfectly mix'd, improperly enough, they being many of them (for ought I know) as ſimple as thoſe they call Elements. Theſe are *Stones*, *Metals*, *Minerals*, and *Salts*.

In *Stones*, which one would think were a neglected *Genus*, What Variety? What Beauty and Elegancy? What Conſtancy in their Temper and Conſiſtency in their Figures and Colours? I ſhall ſpeak of firſt ſome notable Qualities wherewith ſome of them are endued; Secondly, The remarkable Uſes they are of to us. The Qualities I ſhall inſtance in are, Firſt, *Colour*, which in ſome of them is moſt lively, ſparkling, and beautiful; the *Carbuncle* or *Rubine* ſhining with red, the *Sapphire* with blue, the *Emerauld* with green, the *Topaz*, or *Chryſolyte of the Ancients*, with a yellow or Gold-colour, the *Amethyſt* as it were tinctur'd with Wine, the *Opal* varying its Colours like changeable Taffata, as it is diverſly expos'd to the Light. Secondly, *Hardneſs*, wherein ſome Stones exceed all other Bodies, and among them the *Adamant* all other Stones, being exalted to that Degree thereof, that Art in vain endeavours to counterfeit it, the fictitious Stones of Chymiſts in Imitation being eaſily detected by an ordinary Lapidiſt. Thirdly, *Figure*: Many of them ſhoot into regular Figures, as *Chryſtal* and *Baſtard-Diamonds* into hexagonal; others into thoſe that are more elegant and compounded, as thoſe form'd in Imitation of the Shells of Teſtaceous Fiſhes of all Sorts, Sharks Teeth and Vertebres, *&c.* If theſe be originally Stones, or primary Productions of Nature in Imitation of Shells, and Fiſhes Bones, and not the Shells and Bones themſelves petrified, as we have ſometimes thought. Some have a Kind of Vegetation and Reſemblance of Plants, as *Corals*, *Pori*, and *Fungites*, which grow upon the Rocks like Shurbs: To which I might add our ordinary *Star-Stones* and *Trochites*, which I look upon as a Sort of Rock-Plants.

Secondly, For the Uſes; ſome ſerve for Building, and many Sorts of Veſſels and Utenſils; for Pillars, and Statues, and other carv'd Works in *relievo*, for the Temples, Ornament of Palaces, Portico's, Piazza's, Conduits, *&c.* as Freeſtone and Marble; ſome to burn into Lime, as Chalk and Lime-ſtone; ſome, with the Mixture of *Beriglia* or *Kelp*, to make Glaſs, as that the *Venetians* call *Cuogulo*, and common Flints, which ſerve alſo to ſtrike Fire; ſome to cover Houſes, as Slates, ſome for marking, as *Morochthus*, and the fore-mention'd Chalk, which is a πολύχρηστον, ſerving moreover for manuring Land, and ſome Medicinal Uſes; ſome to make Veſſels of which will endure the Fire, as that found in the Country of *Chiavenna* near *Plurs.* To theſe uſeful Stones I might add the *Warming-ſtone*, digg'd in *Cornwall*, which being once well heated at the Fire, retains its Warmth a great while, and hath been found to give Eaſe and Relief in ſeveral Pains and Diſeaſes, particularly in that of the internal Hæmorrhoids. I might alſo take Notice, that ſome Stones are endued with an *Electrical* or attractical Virtue.
“ My honoured Friend Dr. *Tancred Robinſon*,
“ in his Manuſcript *Itinerary of Italy*, relates
“ the many various Figures he obſerv'd na-
“ turally delineated and drawn on ſeveral Sorts
“ of Stones digged up in the Quarries, Caverns
“ and Rocks, about *Florence*, and other Parts
“ of *Italy*, not only repreſenting Cities, Moun-
“ tains, Ruins, Clouds, Oriental Characters,
“ Rivers, Woods, Animals, but alſo ſome

"Plants (as Ivy, Moſſes, Maiden-hair, Ferns, "and ſuch Vegetables as grow in thoſe Places) "ſo exactly deſign'd and impreſs'd upon ſeveral "Kinds of Stones, as though ſome skilful Pain-"ters or Sculpters had been working upon "them. The *Doctor* obſerves alſo the wonder-"ful Diverſity of Shapes and Colours that Oars "and other Foſſils ſhoot into, reſembling al-"moſt every Thing in Nature, for which it "ſeems very difficult to him to aſſign any Cauſe "or Principle. In the *Pyrites* alone he believes "he himſelf may have ſeen at home and abroad "above a hundred Varieties, and yet he "confeſſes he has been but a rude Obſerver of "them. In the Diaphanous Foſſils (as Ambers, "Cryſtals, Agates, *&c.*) preſerv'd in the Ca-"binets of the Great Duke of *Tuſcany*, Cardi-"nal *Chigi*, *Settali*, *Moſcardi*, and other Repo-"ſitories or Muſæums of that curious Country, "he takes Notice of the admirable Diverſity "of Bodies included, and naturally impriſon'd "within them, as Flies, Spiders, Frogs, Lo-"cuſts, Bees, Piſmires, Gnats, Graſhoppers, "Drops of Liquor, Hair, Leaves, Ruſhes, "Moſs, Seeds, and other Herbage; which ſeem "to prove them to have been once in a State "of Fluidity. The *Bononia* Stone digg'd up "in the *Appenines* is remarkable for its ſhining "Quality. The *Amianthus* for its Incombuſ-"tibility. The *Oculus Mundi* for its Motion "and Change of Colour. The *Lapis Nephri-*"*ticus*, *Calaminaris*, *Oſtiocolla*, *Ætites*, *&c.* for "their Medicinal Uſes."

I might ſpend much Time in the diſcourſing of the moſt ſtrange and unaccountable Nature and Power of the Loadſtone, a Subject which hath exercis'd the Wits and Pens of the moſt acute and ingenious Philoſophers; and yet the *Hypotheſes* which they have invented to give an Account of its admirable *Phænomena* ſeems to me lame and unſatisfactory. What can we ſay of the Subtlety, Activity, and Penetrancy of its *Effluvia*, which no Obſtacle can ſtop or repel, but they will make their Way through all Sorts of Bodies, firm and fluid, denſe and rare, heavy and light, pellucid and opake? Nay, they will paſs through a Vacuity or empty Space, at leaſt devoid of Air and any other ſenſible Body. Its attractive Power of Iron was known to the Ancients: Its Verticity and Direction to the Poles of the Earth is of later Invention; which, of how infinite advantage it hath been to theſe two or three laſt Ages, the great Improvement of Navigation, and Advancement of Trade and Commerce, by rendring the remoteſt Countries eaſily acceſſible; the noble Diſcovery of a vaſt Continent or new World, beſides a Multitude of unknown Kingdoms and Iſlands; the Reſolving experimentally thoſe ancient Problems of the Spherical Roundneſs of the Earth; of the Being of *Antipodes*, or the Habitableneſs of the *Torrid Zone*; and the Rendring the whole Terraqueous Globe circumnavigable; do abundantly demonſtrate: Whereas formerly they were wont to coaſt it, and creep along the Shores, ſcarce daring to venture out of the Ken of Land when they did, having no other Guide but the *Cynoſura* or Pole-Star, and thoſe near it, and in cloudy Weather none at all.

As for *Metals*, they are ſo many ways uſeful to Mankind, and thoſe Uſes ſo well known to all, that it would be loſt Labour to ſay any Thing of them: Without the Uſe of theſe we could have nothing of Culture or Civility; no Tillage or Agriculture; no Reaping or Mowing; no Plowing, or Digging; no Pruning or Lopping, Grafting or Inciſion; no mechanical Arts or Trades; no Veſſels or Utenſils of Houſhold-ſtuff; no convenient Houſes or Edifices; no Shipping or Navigation. What a Kind of barbarous and ſordid Life we muſt neceſſarily have liv'd, the *Indians* in the Northern Part of *America* are a clear Demonſtration. Only it is remarkable, that thoſe which are of moſt frequent and neceſſary Uſe, as Iron, Braſs and Lead, are the moſt common and plentiful: Others that are more rare, may better be ſpar'd, yet are they thereby qualified to be made the common Meaſure and Standard of the Value of all other Commodities, and ſo ſerve for Coin or Money, to which Uſe they have been employ'd by all civil Nations in all Ages.

Now, of what mighty Importance the Uſe of Money is to Mankind, the Learned and Ingenious Dr. *Cockburn* ſhews us, in the *Second Part* of his *Eſſay* concerning the *Nature of Chriſtian Faith*, *p.* 88. Whenever, ſaith he, the Uſe of Money began, it was an admirable Contrivance for rewarding and encouraging Induſtry, for carrying on Trade and Commerce certainly, eaſily, and ſpeedily, for obliging all to employ their various Parts and ſeveral Capacities for the common Good, and engaging every one to communicate the Benefit of his particular Labour, without any Prejudice to himſelf. Covetouſneſs indeed, or an inordinate Love of Money, is vicious, and the Root of much Evil, and ought to be remedied; but the Uſe of Money, is neceſſary, and attended with manifold Advantages. Where Money has not yet taken Place, where the Uſe of it hath not yet been introduc'd, Arts and Sciences are not cultivated, nor any of thoſe Exerciſes ply'd, which polite Mens Spirits, and which abate the Uneaſineſs of Life. Men there are brutiſh and ſavage, none mind any Thing but Eating and Dringing, and the other Acts of brutal Nature; their Thoughts aſpire no higher than merely to maintain their Life and Breath: Like the Beaſts they walk abroad all the Day long, and range about from Place to Place, only to ſeek their Food. Whatever may be ſuppos'd to follow if all were acted with great Generoſity and true Charity, yet, according to the preſent Temper of Mankind, it is abſolutely neceſſary that there be ſome Method and Means of Commutation, as that of Money, for rendering all and every one mutually uſeful and ſerviceable.

Now Gold and Silver by their Rarity are wonderfully fitted and accommodated for this Uſe of Permutation for all Sorts of Commodities, or making Money of: Whereas were they as common and eaſie to come by as Straw or Stubble, Sand or Stones, they would be of no more Uſe for Bartering and Commerce than they.

And here he goes on to ſhew the wonderful Providence of God, in keeping up the Value of Gold and Silver, notwithſtanding the vaſt Quantities which have been digg'd out of the Earth in all Ages, and ſo continuing them a fit Material to make Money of. For which I refer to the Book.

Of theſe, Gold is remarkable for its admirable Ductility and Ponderoſity, wherein it excels all other Bodies hitherto known. I ſhall only add concerning Metals, that they do Pertinaciouſly reſiſt all Tranſmutation; and tho' one would ſometimes think they were turn'd into a different Subſtance, yet do they but as it were lurk under a *Larva* or Vizzard, and may be reduc'd again into their natural Form and Complexions, in Diſpite of all the Tortures of *Vulcan* or corroſive Waters. Note, *That this was written above Thirty Years ſince, when I thought I had Reaſon to diſtruſt whatever had then been reported or written to affirm the Tranſmutation of Metals one into another.*

I ſhall omit the Conſideration of other Minerals, and of Salts and Earths, becauſe I have nothing to ſay of their Uſes, but only ſuch as refer to Man, which I cannot affirm to have been the ſole or primary End of the Formation of them. Indeed, to ſpeak in general of theſe Terreſtrial Inanimate Bodies, they having no ſuch Organization of Parts as the Bodies of Animals, nor any ſo intricate Variety of Texture, but that their Production may plauſibly be accounted for by an *Hypotheſis* of Matter divided into minute Particles or Atoms naturally indiviſible, of various but a determinate Number of Figures, and perhaps alſo differing in Magnitude, and theſe mov'd, and continually kept in Motion according to certain eſtabliſh'd Laws or Rules; we cannot ſo clearly diſcover the Uſes for which they were created, but may probably conclude, that among other Ends they were made for thoſe for which they ſerve us and other Animals; as I ſhall more fully make out hereafter. It is here to be noted, That, according to our *Hypotheſis*, the Number of the Atoms of each ſeveral Kind that is of the ſame Figure and Magnitude is not nearly equal, but there be infinitely more of ſome *Species* than of others, as of thoſe that compound thoſe vaſt Aggregates of *Air*, *Water*, and *Earth*, more abundantly than of ſuch as make up *Metals* and *Minerals*: The Reaſon whereof may probably be, becauſe thoſe are neceſſary to the Life and Being of Man and all other Animals, and therefore muſt be always at Hand, theſe only uſeful to Man, and ſerving rather his Conveniences than Neceſſities. The Reaſon why I affirm the minute component Particles of Bodies to be naturally indiviſible by any Agent we can imploy, (even Fire it ſelf) which is the only Catholick Diſſolvent, other *Menſtruums* being rather Inſtruments than Efficients in all Solutions, apt by Reaſon of the Figure and Smalneſs of their

Parts to cut and divide other Bodies (as Wedges cleave Wood) when actuated by Fire or its Heat, which elſe would have no Efficacy at all (as Wedges have not, unleſs driven by a Beetle:) The Reaſon, I ſay, I have already given; I ſhall now Inſtance in a Body whoſe minute Parts appear to be indiſſoluble by the Force of Fire, and that is common Water, which diſtil, boil, circulate, work upon how you will by Fire, you can only diſſolve it into Vapour, which when the Motion ceaſes, eaſily returns into Water again; Vapour being nothing elſe but the minute Parts thereof, by Heat agitated and ſeparated one from another. For another inſtance, ſome of the moſt learn'd and experienc'd Chymiſts do affirm Quickſilver to be intranſmutable, and therefore call it *Liquor æternus*, And I am of Opinion, that the ſame holds of all ſimple Bodies, that their component Particles are indiſſoluble by any natural Agent.

We may here note the Order and Method that Metals and Minerals obſerve in their Growth, how regularly they ſhoot, ferment, and as it were vegetate and regenerate; Salts in their proper and conſtant Figures; as our ingenious Countryman Dr. *Jordan* obſerves at large in his Diſcourſe of Baths and Mineral Waters.

Of Vegetables or Plants.

I have now done with inanimate Bodies both ſimple and mix'd. The Animate are,

Firſt, Such as are endued only with a Vegetative Soul, and therefore commonly called *Vegetables* or *Plants*; of which, if we conſider either their Stature and Shape, or their Age and Duration, we ſhall find it wonderful; for why ſhould ſome Plants riſe up to a great Height, others creep upon the Ground, which perhaps may have equal *Seeds?* nay, the leſſer Plant many Times the greater Seed. Why ſhould each Particular ſo obſerve its Kind, as conſtantly to produce the ſame Leaf for Conſiſtency, Figure, Diviſion and Edging, and bring forth the ſame Kind of Flower, and Fruit, and Seed? and that tho' you tranſlate it into a Soil which naturally puts forth no ſuch Kind of Plant, ſo that it is ſome * Λόγος σωερματικὸς, which doth effect this or rather ſome intelligent *plaſtick Nature*; as we have before intimated: For what Account can be given of the Determination of the Growth and Magnitude of Plants from Mechanical Principles, of *Matter mov'd* without the Preſidency and Guidance of ſome ſuperiour Agent? Why may not Trees grow up as high as the Clouds or Vapours aſcend? or if you ſay the Cold of the ſuperiour Air checks them, Why may they not ſpread and extend their lateral Branches ſo far till their Diſtance from the Centre of Gravity depreſs them to the Earth, be the Tree never ſo high? How comes it to paſs that tho' by Culture and Manure they may be highly improv'd, and augmented to a double, treble, nay, ſome a much greater Proportion in Magnitude of all their Parts, yet is this Advance reſtrain'd within certain Limits?

* Seminal From or Virtue.

mits? There is a *maximum quod ſic* which they cannot exceed. You can by no Culture or Art extend a *Fennel-Stalk* to the Stature and Bigneſs of an *Oak:* Then why ſhould ſome be very long-liv'd, others only Annual or Biennial? How can we imagine that any Laws of Motion can determine the *Situation* of the *Leaves*, to come forth by Pairs, or alternately, or circling the Stalk; the *Flowers* to grow ſingly, or in Company and Tufts, to come forth the Boſoms of the Leaves and Branches, or on the Tops of Branches and Stalks? the *Figure* of the Leaves, that they ſhould be divided into ſo many Jags or Eſcallops, and curiouſly indented round the Edges; as alſo of the Flower-leaves, their Number and Site, the Figure and Number of the *Stamina* and their *Apices*, the Figure of the *Stile* and Seed-Veſſel, and the Number of Cells into which it is divided. That all this be done, and all theſe Parts duly proportion'd one to another, there ſeems to be neceſſary ſome intelligent *plaſtick Nature*, which may underſtand and regulate the whole Oeconomy of the Plant: For this cannot be the Vegetative Soul, becauſe that is material and diviſible together with the Body; which appears, in that a Branch cut off of a Plant will take Root, and grow, and become a perfect Plant it ſelf, as we have already obſerv'd. I had almoſt forgotton the Complication of the Seed-leaves of ſome Plants in the Seed, which is ſo ſtrange, that one cannot believe it to be done by Matter, however mov'd by any Laws or Rules imaginable. Some of them being ſo cloſe-plaited, and ſtraitly folded up and thruſt together within the Membranes of the Seed, that it would puzzle a Man to imitate it, and yet none of the Folds ſticking or growing together; ſo that they may eaſily be taken out of their Caſes, and ſpread and extended even with one's Fingers.

Secondly, If we conſider each particular Part of a Plant, we ſhall find it not without its End or Uſe; the *Roots*, for its Stability and drawing Nouriſhment from the Earth, the *Fibres*, to contain and convey the Sap; beſides which, there is a large Sort of Veſſels to contain the proper and ſpecifick Juice of the Plant, and others to carry Air for ſuch a Kind of Reſpiration as it needeth; of which we have already ſpoken. The outer and inner Bark in Trees ſerve to defend the Trunk and Boughs from the Exceſſes of Heat and Cold and Drought, and to convey the Sap for the annual Augmentation of the Tree; for in Truth, every Tree may in ſome Senſe be ſaid to be an annual Plant, both Leaf, Flower and Fruit, proceeding from the Coat that was ſuperinduced over the Wood the laſt Year, which Coat alſo never beareth any more, but together with the old Wood ſerves as a Form or Block to ſuſtain the ſucceeding annual Coat. The *Leaves* before the *Gemma* or Bud be explicated to embrace and defend the Flower and Fruit, which is even then perfectly form'd; afterwards to preſerve the Branches, Flowers and Fruit from the Injuries of the Summer Sun, which would too much parch and dry them, if they lay open and expos'd to its Beams without any Shelter: The Leaves, I ſay, qualifie and contemper the Heat, and ſerve alſo to hinder the too haſty Evaporation of the Moiſture about the Root: But the principal Uſe of the Leaves (as we learn of Seignior *Malphigii*, Monſieur *Perault*, and Monſieur *Mariotte*) is to concoct and prepare the Sap for the Nouriſhment of the Fruit, and the whole Plant, not only that which aſcends from the Root, but what they take in from without, from the Dew, moiſt Air and Rain. This they prove becauſe many Trees, if diſpoil'd of their Leaves, will die; as it happens ſometimes in *Mulberry-Trees*, when they are pluck'd off to feed *Silk-worms*. And becauſe if in Summer-Time you denude a Vine-Branch of its Leaves, the Grapes will never come to Maturity: But tho' you expoſe the Grapes to the Sun-Beams, if you pluck not off the Leaves, they will ripen notwithſtanding. That there is a Regreſs of the Sap in Plants from above downwards, and that this deſcendent Juice is that which principally nouriſheth both Fruit and Plant, is clearly proved by the Experiments of Seignior *Malphigii*, and thoſe rare ones of an Ingenious Country Man of our own * *Thomas Brotherton* Eſquire, of which I ſhall mention only one, that is, If you cut off a Ring of Bark from the Trunk of any Tree, that Part of the Tree above the Barked Ring ſhall grow and increaſe in Bigneſs, but not that beneath.

* Philoſop. Tranſact. Num. 187.

But whether there be ſuch a conſtant Circulation of the Sap in Plants as there is of the Blood in Animals, as they would from hence infer, there is ſome Reaſon to doubt. I might add hereto the pleaſant and delectable cooling and refreſhing Shade they afford in the Summer-Time; which was very much eſteem'd by the Inhabitants of hot Countries, who always took great Delight and Pleaſure to ſit in the open Air, under ſhady Trees: Hence that Expreſſion ſo often repeated in Scripture, of every Man's *ſitting under his own Vine, and under his own Fig-Tree*, where alſo they us'd to eat; as appears by *Abraham*'s entertaining the Angels under a Tree, and ſtanding by them when they did eat, *Gen.* xviii. 8. Moreover, the Leaves of Plants are very beautiful and ornamental. That there is great Pulchritude and Comelineſs of Proportion in the Leaves, Flowers and Fruits of Plants, is atteſted by the general Verdict of Mankind, as Dr. *More* and others well obſerve. The adorning and beautifying the Temples and Buildings in all Ages, is an evident and undeniable Teſtimony of this; for what is more ordinary with *Architects* than the taking in Leaves and Flowers and Fruitage for the garniſhing of their Work; as the *Roman* the Leaves of *Achanthus ſat.* and the *Jewiſh* of *Palm-Trees* and *Pomegranets*: And theſe more frequently than any of the five regular Solids, as being more comely and pleaſant to behold. If any Man ſhall object, that Comelineſs of Proportion and Beauty is but a mere Conceit, and that all Things are alike handſome to ſome Men who have as good Eyes as others; and that this appears by the Variation of Faſhions, which doth ſo alter Mens Fancies, that what e're-while ſeem'd very handſome and comely, when it is once worn out of Faſhion appears very abſurd, uncouth and ridiculous. To this I anſwer, That Cuſtom and Uſe doth much in thoſe Things where little of Proportion and Symmetry ſhew themſelves, or which are alike comely and beautiful, to diſparage the one, and commend the other: But there are Degrees of Things; for (that I may uſe * Dr. *More's* Words) I dare appeal to any Man that is not ſunk into ſo forlorn a Pitch of Degeneracy, that he is as ſtupid to theſe Things as the baſeſt Beaſts, whether, for Example, a rightly-cut *Tetraedrum*, *Cube* or *Icoſaedrum* have no more Pulchritude in them than any rude broken Stone lying in the Field or High-ways; or, to name other ſolid Figures, which tho' they be not regular, properly ſo call'd, yet have a ſettled *Idea* and Nature, as a *Cone*, *Sphere* or *Cylender*, whether the Sight of thoſe do not more gratify the Minds of Men, and pretend to more Elegancy of Shape than thoſe rude Cuttings or Chippings of Free-ſtone that fall from the Maſon's Hands, and ſerve for nothing but to fill up the Middle of the Wall, as fit to be hid from the Eyes of Men for their Uglineſs. And therefore it is obſervable, that if Nature ſhape any Thing but near to this *Geometrical*

* Antidote. againſt Atheiſm, *l.* 2. *c.* 5.

metrical Accuracy, that we take Notice of it with much Content and Pleaſure, and greedily gather and treaſure it up. As if it be but exactly round, as thoſe ſpherical Stones found in *Cuba*, and ſome alſo in our own Land, or have but its Sides parallel, as thoſe rhomboideal *Selenites* found near *St. Ives* in *Huntingtonſhire*, and many other Places in *England*. Whereas ordinary Stones of rude and uncertain Figures we paſs by, and take no Notice of at all. But tho' the Figures of theſe Bodies be pleaſing and agreable to our Minds, yet (as we have already obſerv'd) thoſe of the Leaves, Flowers and Fruits of Trees, more. And it is remarkable, that in the Circumſcription and Complication of many Leaves, Flowers, Fruits, and Seed, Nature affects a regular Figure. Of a Pentagonal or Quincunial Diſpoſition, Sir *Thomas Brown* of *Norwich* produces ſeveral Examples in his Diſcourſe about the *Quicunx*. And doubtleſs Inſtances might be given in other regular Figures, were Men but obſervant.

The *Flowers* ſerve to cheriſh and defend the firſt and tender Rudiments of the Fruit; I might alſo add the maſculine or prolifick Seed contain'd in the Chives or *Apices* of the *Stamina*. Theſe, beſides the Elegancy of their Figures, are many of them endued with ſplendid and lovely Colours, and likewiſe moſt grateful and fragrant Odours. Indeed ſuch is the Beauty and Luſtre of ſome Flowers, that our Saviour ſaith of the Lillies of the Fields (which ſome, not without Reaſon, ſuppoſe to have been *Tulips*) that *Solomon in all his Glory was not arrayed like one of theſe.*

these. And it is obſerv'd by * *Spigelius*, That the Art of the moſt skilful Painter cannot ſo mingle and temper his Colours, as exactly to imitate or counterfeit the native ones of the Flowers of *Vegetables.*

* *Iſag. ad rem Herbariam.*

As for the *Seeds* of *Plants*, † Dr. *More* eſteems it an evident Sign of Divine Providence, that every Kind hath its Seed: For it being no neceſſary Reſult of the Motion of the Matter, (as the whole Contrivance of the Plant indeed is not) and it being of ſo great Conſequence that they have Seed for the Continuance and Propagation of their own Species, and alſo for the gratifying Man's Art, Induſtry and Neceſſities, (for much of Husbandry and Gardening lies in this) it cannot but be an Act of Counſel to furniſh the ſeveral Kinds of Plants with their Seeds.

† Antidote againſt Atheiſm, *l.* 2. *c.* 2.

Now the *Seed* being ſo neceſſary for the Maintenance and Increaſe of the ſeveral *Species*, it is worthy the Obſervation, what Care is taken to ſecure and preſerve it, being in ſome doubly and trebly defended. As for Inſtance, in the *Walnut*, *Almond*, and *Plumbs* of all Sorts, we have firſt a thick pulpy Covering, then a hard Shell, within which is the Seed enclos'd in a double Membrane. In the *Nutmeg* another Tegument is added beſides all theſe, *viz.* the *Mace* between the green *Pericarpium* and the hard Shell, immediately incloſing the Kernel. Neither yet doth the exteriour Pulp of the Fruit or *Pericarpium* ſerve only for the Defence and

Security of the Seed, whilſt it hangs upon the Plant, but after it is mature and fallen upon the Earth, for the Stercoration of the Soil, and Promotion of the Growth, though not the firſt Germination of the Seminal Plant. Hence (as * *Petrus de Creſcentiis* tells us) Husbandmen, to make their Vines bear, manure them with Vine-leaves, or the Husks of expreſt Grapes; and they obſerve thoſe to be moſt fruitful, which are ſo manured with their own: Which Obſervation holds true alſo in all other Trees and Herbs. But beſides this Uſe of the Pulp or *Pericarpium*, for the Guard and Benefit of the Seed, it ſerves alſo by a ſecondary Intention of Nature in many Fruits for the Food and Suſtenance of Man and other Animals.

Another Thing worthy the noting in *Seeds*, and argumentative of Providence and Deſign, is that papoſe Plumage growing upon the Tops of ſome of them, whereby they are capable of being wafted with the Wind, and by that Means ſcatter'd and diſſeminated far and wide.

Furthermore, moſt *Seeds* having in them a Seminal Plant perfectly form'd, as the Young is in the Womb of Animals, the elegant Complication thereof in ſome *Species* is a very pleaſant and admirable Spectacle; ſo that no Man that hath a Soul in him can imagine or believe it was ſo form'd and folded up without Wiſdom and Providence. But of this I have ſpoken already.

* Agric. *l.* 2. *c.* 6.

Laſtly, The immenſe Smalneſs of ſome Seeds, not to be ſeen by the naked Eye, ſo that the Number of Seeds produced at once in ſome one Plant, as for Example, *Reedmace*, [*Tipha Paluſtris*] *Harts-Tongue*, and many Sorts of *Ferns*, may amount to a Million, is a convincing Argument of the infinite Underſtanding and Art of the Former of them.

And it is remarkable that ſuch *Moſſes* as grow upon Walls, the Roofs of Houſes and other high Places, have Seeds ſo exceſſively ſmall, that when ſhaken out of their Veſſels they appear like Vapour or Smoke, ſo that they may either aſcend of themſelves, or by an eaſie Impulſe of the Wind be rais'd up to the Tops of Houſes, Walls or Rocks: And we need not wonder how the Moſſes got thither, or imagine they ſprung up ſpontaneouſly there.

I might alſo take Notice of many other Particulars concerning Vegetables, as, Firſt, That becauſe they are deſign'd for the Food of Animals, therefore Nature hath taken more extraordinary Care and made more abundant Proviſion for their Propagation and Encreaſe; ſo that they are multiplied and propagated not only by the Seed, but many alſo by the Root, producing Off-ſets or creeping under Ground, many by Strings or Wires running above Ground, as *Strawberry*, and the like, ſome by Slips or Cuttings, and ſome by ſeveral of theſe Ways. And for the Security of ſuch *Species* as are produc'd only by Seed, it hath endued all Seed with a laſting Vitality, that ſo if by Reaſon of exceſſive Cold, or Drought, or any other Accident, it happen not to germinate the firſt Year, it will continue its Fœcundity, I do not ſay two or three, nor ſix or ſeven, but even twenty or thirty Years; and when the Impediment is removed, the Earth in fit Caſe, and the Seaſon proper, ſpring up, bear Fruit, and continue its Species. Hence it is that Plants are ſometimes loſt for a while in Places where they formerly abounded; and again, after ſome Years, appear new: Loſt either becauſe the Springs were not proper for their Germination, or becauſe the Land was fallow'd, or becauſe Plenty of Weeds or other Herbs prevented their coming up, and the like, and *appearing* again when theſe Impediments are removed. Secondly, That ſome Sorts of Plants, as *Vines*, all Sorts of *Pulſe*, *Hops*, *Briony*, all Pomiferous Herbs, *Pumpions*, *Melons*, *Gourds*, *Cucumbers*, and divers other *Species*, that are weak and unable to raiſe or ſupport themſelves, are either endued with a Faculty of twining about others that are near, or elſe furniſh'd with Claſpers and Tendrils, whereby, as it were with Hands, they catch Hold of them, and ſo ramping upon Trees, Shrubs, Hedges or Poles, they mount up to a great Height, and ſecure themſelves and their Fruit. Thirdly, that others are arm'd with Prickles and Thorns, to ſecure them from the Browſing of Beaſts, as alſo to ſhelter others that grow under them. Moreover they are hereby render'd very uſeful to Man, as if deſign'd by Nature to make both Quick and Dead

Hedges and Fences. The great Naturaliſt *Pliny* hath given an Ingenious Account of the Providence and Deſign of Nature in thus arming and fencing them in theſe Words. *Inde* (ſpeaking of Nature) *excogitavit aliquas aſpectu hiſpidas, tactu truces, ut tantùm non vocem ipſius Naturæ fingentis illas, rationemque reddentis exaudire videamur, ne ſe depaſcat avida quadrupes, ne procaces manus rapiant, ne neglecta veſtigia obterant, ne inſidens ales infringat; his muniendo aculeis teliſque armando, remediis ut ſalva ac tuta ſint. Ità hoc quoque quod in iis odimus hominum cauſà excogitatum eſt.*

It is worthy the noting, That *Wheat*, which is the beſt Sort of Grain, of which the pureſt, moſt ſavory and wholeſome Bread is made, is patient of both Extreams, Heat and Cold, growing and bringing its Seed to Maturity, not only in temperate Countries, but alſo on one Hand in the Cold and Northren, *viz. Scotland, Denmark*, &c. on the other, in the hotteſt and moſt Southerly, as *Egypt, Barbary, Mauritania*, the *Eaſt-Indies, Guinea, Madagaſcar*, &c. ſcarce refuſing any Climate.

Nor is it leſs obſervable, and not to be commemorated without Acknowledgement of the Divine Benignity to us, that (as *Pliny* rightly notes,) nothing is more fruitful than *Wheat, Quod ei natura* (ſaith he) [*rectiùs naturæ Parens*] *tribuit, quòd eo maximè hominem alit, utpote cùm è modio, ſi & aptum ſolum, quale in Byzacio Africæ campo centeni quinquaginta modii reddentur. Miſit ex eo loco Divo Auguſto procurator*

rator ejus ex uno grano (vix credibile dictu) 400 *paucis minus germina: Miſit & Neroni ſimiliter* 360 *ſtipulas ex uno grano.* "Which Fertility "Nature, (he ſhould have ſaid, the Author of "Nature) hath conferr'd upon it, becauſe it feeds "Man chiefly with it. One Buſhel, if ſown "in a fit and proper Soil, ſuch as is *Byzacium*, "a Field of *Africa*, yielding 150 of annual "Encreaſe. *Auguſtus*'s *Procurator* ſent him "from that Place 400 within a few Blades "ſpringing from the ſame Grain: And to "*Nero* were ſent thence 360." If *Pliny*, a Heathen, could make this Fertility of Wheat argumentative of the Bounty of God to Man, making ſuch plentiful Proviſion for him of that which is of moſt pleaſant Taſte and wholeſome Nouriſhment, ſurely it ought not to be paſſed over by us *Chriſtians* without Notice taking and Thankſgiving.

As for the Signatures of Plants, or the Notes impreſſed upon them, as *Indices* of their Virtues, tho' * ſome lay great Streſs upon them, accounting them ſtrong Arguments to prove, that ſome underſtanding Principle is the higheſt Original of the Works of Nature; as indeed they were, could it certainly be made appear, that there were ſuch Marks deſignedly ſet upon them; becauſe all that I find mention'd and collected by Authors, ſeem to me to be rather fancied by Men, than deſign'd by Nature to ſignifie or point out any ſuch Virtues or Qualities as they would make us believe. I have elſewhere, I think

* Dr. *More* Antid. l. 2. c. 6.

upon good Grounds, rejected them; and finding no Reaſon, as yet, to alter my Opinion, I ſhall not further inſiſt on them: Howbeit, I will not deny, but that the noxious and malignant Plants do many of them diſcover ſomething of their Nature by the ſad and melancholick Viſage of their Leaves, Flowers and Fruit. And that I may not leave that Head wholly untouch'd, one Obſervation I ſhall add relating to the Virtues of Plants, in which I think there is ſomething of Truth; that is, that there are, by the wiſe Diſpoſition of Providence, ſuch *Species* of Plants produc'd in every Country, as are moſt proper aud convenient for the Meat and Medicine of the Men and Animals that are bred and inhabit there: Inſomuch that *Solenander* writes, that from the Frequency of the Plants that ſprung up naturally in any Region, he could eaſily gather what Endemial Diſeaſes the Inhabitants thereof were ſubject to: So in *Denmark*, *Friezland*, and *Holland*, where the Scurvy uſually reigns, the proper Remedy thereof, *Scurvy-graſs*, doth plentifully grow.

Of Bodies endued with a ſenſitive Soul, or Animals.

I proceed now to the Conſideration of Animate Bodies endu'd with a ſenſitive Soul, call'd *Animals*: Of theſe I ſhall only make ſome general Obſervations, not curiouſly conſider the Parts of each particular *Species*, ſave only as they ſerve for Inſtances or Examples.

Firſt of all, becauſe it is the great Deſign of

Providence to maintain and continue every Species, I ſhall take Notice of the great Care and abundant Proviſion that is made for the ſecuring this End. *Quanta ad eam rem vis, ut in ſuo quæque genere permaneat? Cic.* Why can we imagine all Creatures ſhould be made Male and Female but to this Purpoſe? Why ſhould there be implanted in each Sex ſuch a vehement and inexpugnable Appetite of Copulation? Why in viviparous Animals, in the Time of Geſtation, ſhould the Nouriſhment be carried to the *Embryon* in the Womb, which at other Times goeth not that Way? When the Young is brought forth, how comes all the Nouriſhment then to be transferr'd from the Womb to the Breaſt or Paps, leaving its former Chanel, the Dam at ſuch Time being for the moſt Part lean and ill-favour'd? To all this I might add, as a great Proof and Inſtance of the Care that is taken, and Proviſion made for the Preſervation and Continuance of the Species, the laſting Fœcundity of the Animal Seed or Egg in the Females of Man, Beaſts and Birds. I ſay, the Animal Seed, becauſe it is to me highly probable, that the Females, as well of Beaſts as Birds, have in them from their firſt Formation the Seeds of all the Young they will afterwards bring forth, which when they are all ſpent and exhauſted by what Means ſoever, the Animal becomes barren and effete. Theſe Seeds in ſome Species of Animals continue Fruitful, and apt to take Life by the Admixture of the Male-ſeed fifty Years or more, and in ſome Birds fourſcore or an hundred. Here I cannot omit one very remarkable Obſervation I find in *Cicero*: *Atque ut intelligamus* (ſaith he) *nihil horum eſſe fortuitum; ſed hæc omnia providæ ſolertiſque naturæ, quæ multiplices fœtus procreant, ut ſues, ut canes, his mammarum data eſt multitudo, quas eaſdem paucas habent eæ beſtiæ quæ pauca gignunt. That we may underſtand that none of theſe Things* (he had been ſpeaking of) *is fortuitous, but that all are the Effects of provident and ſagacious Nature; multiparous Quadrupeds, as Swine, as Dogs, are furniſhed with a Multitude of Paps: Whereas thoſe Beaſts which bring forth few, have but a few.*

That flying Creatures of the greater Sort, that is *Birds*, ſhould all lay Eggs, and none bring forth live Young, is a manifeſt Argument of Divine Providence, deſigning thereby their Preſervation and Security, that there might be the more Plenty of them; and that neither the Birds of Prey, the Serpent, nor the Fowler, ſhould ſtraiten their Generations too much: For if they had been viviparous, the Burden of their Womb, if they had brought forth any competent Number at a time, had been ſo great and heavy, that their Wings would have fail'd them, and they become an eaſie Prey to their Enemies: Or, if they had brought but one or two at a time, they would have been troubled all the Year long with feeding their Young, or bearing them in their Womb. *Dr.* More *Antid. Atheiſm, l.* 2. *c.* 9.

This Mention of feeding their Young puts me in mind of two or three conſiderable Obſervations referring thereto.

Firſt, Seeing it would be for many Reaſons inconvenient for Birds to give Suck, and yet no leſs inconvenient, if not deſtructive, to the Chicken upon Excluſion, all of a ſudden, to make ſo great a Change in its Diet, as to paſs from liquid to hard Food, before the Stomach be gradually conſolidated, and by Uſe ſtrengthen'd and habituated to grind and concoct it, and its tender and pappy Fleſh fitted to be nouriſh'd by ſuch ſtrong and ſolid Diet, and before the Bird be by little and little accuſtom'd to uſe its Bill, and gather it up, which at firſt it doth but very ſlowly and imperfectly; therefore Nature hath provided a large Yolk in every Egg, a great Part whereof remaineth after the Chicken is hatch'd, and is taken up and enclos'd in its Belly, and by a Chanel made on purpoſe, receiv'd by degrees into the Guts, and ſerves inſtead of Milk to nouriſh the Chick for a conſiderable time; which nevertheleſs mean while feeds it ſelf by the Mouth a little at a time, and gradually more and more, as it gets a perfecter Ability and Habit of gathering up its Meat, and its Stomach is ſtrengthen'd to macerate and concoct it, and its Fleſh harden'd and fitted to be nouriſh'd by it.

Secondly, That Birds which feed their Young in the Neſt, tho' in all likelihood they have no ability of counting the Number of them, ſhould yet (tho' they bring but one Morſel of Meat at a time, and have not fewer (it may be) than ſeven or eight Young in the Neſt together, which at the Return of their Dams, do all at once with equal Greedineſs, hold up their Heads and gape) not omit or forget one of them, but feed them all; which, unleſs they did carefully obſerve and retain in Memory which they had fed, which not, were impoſſible to be done: This, I ſay, ſeems to me moſt ſtrange and admirable, and beyond the Poſſibility of a mere Machine to perform.

Another Experiment I ſhall add, to prove, that tho' Birds have not an exact Power of numbring, yet have they of diſtinguiſhing many from few, and knowing when they come near to a certain Number: And that is, that when they have laid ſuch a Number of *Eggs*, as they can conveniently cover and hatch, they give over and begin to ſit; not becauſe they are neceſſarily determined to ſuch a Number; for that they are not, as is clear, becauſe they are in Ability to go on and lay more at their Pleaſure. Hens, for Example, if you let their *Eggs* alone, when they have laid fourteen or fifteen, will give over and begin to ſit; whereas, if you daily withdraw their *Eggs*, they will go on to lay five Times that Number: [Yet ſome of them are ſo cunning, that if you leave them but one *Egg*, they will not lay to it, but forſake their Neſt.] This holds not only in domeſtick and manſuete Birds, for then it might be thought the Effect of Cicuration or Inſtitution, but alſo in the wild; for my honour'd Friend Dr. *Martin Liſter* inform'd me, that of his own Knowledge one and the ſame *Swallow*, by the ſubſtracting daily of her *Eggs*, proceeded to lay nineteen ſucceſſively, and then gave over; as I have * elſewhere noted.

Now that I am upon this Subject of the Number of *Eggs*, give me Leave to add a remarkable Obſervation referring thereto, *viz.* That Birds, and ſuch oviparous Creatures, as are long-liv'd, have *Eggs* enough at firſt conceiv'd in them to ſerve them for many Years laying, probably for as many as they are to live, allowing ſuch a Proportion for every Year, as will ſerve for one or two Incubations; whereas Inſects, which are to breed but once, lay all their *Eggs* at once, have they never ſo many. Now, had theſe Things been govern'd by Chance, I ſee no Reaſon why it ſhould conſtantly fall out ſo.

Thirdly, The marvellous Speedy Growth of Birds that are hatch'd in Neſts, and fed by the Old ones there, 'till they be fledg'd, and come almoſt to their full Bigneſs, at which Perfection they arrive within the ſhort Term of about one Fortnight, ſeems to me an Argument of Providence, deſigning thereby their Preſervation, that they might not lie long in a Condition expos'd to the Ravine of any Vermine that may find them, being utterly unable to eſcape or ſhift for themſelves.

Another and no leſs effectual Argument may be taken from the Care and Providence us'd for the Hatching and Rearing their Young: And firſt, they ſearch out a ſecret and quiet Place where

* Preface to Mr. *Willoughby's* Ornithol.

where they may be ſecure and undiſturb'd in their Incubation; then they make themſelves Neſts every one after his Kind, that ſo their *Eggs* and *Young* may lie ſoft and warm, and their Excluſion and Growth be promoted. Theſe Neſts are ſome of them ſo elegant and artificial, that it is hard for Man to imitate them and make the like. I have ſeen Neſts of an *Indian* Bird ſo artificially compos'd of the Fibres, I think, of ſome Roots, ſo curiouſly interwoven and platted together, as is admirable to behold: Which Neſts they hang on the End of the Twigs of Trees over the Water, to ſecure their *Eggs* and *Young* from the Ravage of *Apes* and *Monkeys*, and other Beaſts, that might elſe prey upon them. After they have laid their *Eggs*, how diligently and patiently do they ſit upon them 'till they be hatch'd, ſcarce affording themſelves time to go off to get them Meat? Nay, with ſuch an ardent and impetuous Deſire of ſitting are they inſpired, that if you take away all their *Eggs*, they will ſit upon an empty Neſt: And yet one would think that ſitting were none of the moſt pleaſant Works. After their Young are hatch'd, for ſome time they do almoſt conſtantly brood them under their Wings, leſt the Cold and ſometimes perhaps the Heat ſhould harm them. All this while alſo they labour hard to get them Food, ſparing it out of their own Bellies, and pining themſelves almoſt to Death rather than they ſhould want. Moreover, it is admirable to obſerve, with what Courage they are at that time inſpir'd, that they will even venture their own Lives in defence of them. The moſt timorous, as *Hens* and *Geeſe*, become then ſo couragious, as to dare to fly in the Face of a Man that ſhall moleſt or diſquiet their Young, which would never do ſo much in their own defence. Theſe things being contrary to any motions of Senſe, or inſtinct of Self-preſervation, and ſo eminent pieces of ſelf-denial, muſt needs be the Works of Providence, for the continuation of the Species, and upholding of the World: Eſpecially if we conſider that all theſe pains is beſtow'd upon a thing which takes no notice of it, will render them no thanks for it, nor make them any requital or amends; as alſo, that after the *Young* is come to ſome growth, and able to ſhift for it ſelf, the old one retains no ſuch ϛοργὴ to it, take no further care of it, but will fall upon it, and beat it indifferently with others. To theſe I ſhall add three Obſervations more relating to this Head. The firſt borrow'd of Dr. *Cudworth*, Syſtem, *pag. 69.* One thing neceſſary to the Conſervation of the *Species* of Animals; that is, the keeping up conſtantly in the World a due numerical Proportion between the Sexes of *Male* and *Female*, doth neceſſarily infer a ſuperintending Providence. For did this depend only upon Mechaniſm, it cannot well be conceiv'd, but that in ſome Ages or other there ſhould happen to be all *Males*, or all *Females*, and ſo the Species fail. Nay, it cannot well be thought otherwiſe, but that there is in this a Providence, ſuperior to that of the *Plaſtick* or *Spermatick Nature*, which hath not ſo much of Knowledge and Diſcretion allow'd to it, as whereby to be able to govern this Affair.

The Second of Mr. *Boyle* in his Treatiſe of the *high Veneration Man's Intellect owes to God*. p. 32. that is, the Conveniency of the Seaſon (or Time of Year) of the Production of Animals, when there is proper Food and Entertainment ready for them. *So we ſee, that, according to the uſual Courſe of Nature, Lambs, Kids, and many other living Creatures, are brought into the World at the Spring of the Year; when tender Graſs, and other Nutritive Plants, are provided for their Food. And the like may be obſerv'd in the Production of Silk-worms*, (yea, all other Eruca's, and many Inſects more) *whoſe Eggs, according to Nature's Inſtitution, ~~are~~ hatch'd when Mulberry-Trees begin to bud, and put forth thoſe Leaves, whereon thoſe precious Inſects are to feed; the Aliments being tender, whilſt the Worms themſelves are ſo, and growing more ſtrong and ſubſtantial, as the Inſects encreaſe in Vigour and Bulk.* To theſe I ſhall add another Inſtance, that is of the *Waſp*, whoſe Breeding is deferr'd till after the Summer-Solſtice, few of them appearing before *July*: Whereas one would be apt to think the vigorous and quickning Heat of the Sun in the Youth of the Year ſhould provoke them to generate much ſooner: [Provoke them, I ſay, becauſe every Waſp's-Neſt is begun by one great Mother-Waſp, which over-lives the Winter, lying hid in ſome hollow Tree or other *Latibulum*;] becauſe then, and not till then, Pears, Plumbs, and other Fruit, deſign'd principally for their Food, begin to ripen.

The Third is mine own, That all Inſects which do not themſelves feed their Young, nor treaſure up Proviſion in Store for their Suſtenance, lay their *Eggs* in ſuch Places as are moſt convenient for their Excluſion, and where, when hatch'd, their proper Food is ready for them: So, for Example, we ſee two Sorts of white *Butterflies* faſtening their *Eggs* to Cabbage-Leaves, becauſe they are a fit Aliment for the *Catterpillers* that come of them; whereas ſhould they affix them to the Leaves of a Plant improper for their Food, ſuch Catterpillers muſt needs be loſt, they chuſing rather to die than to taſte of ſuch Plants; for that Kind of Inſect (I mean Catterpillers) hath a nice and delicate Palate, ſome of them feeding only upon one particular *Species* of Plant, others on divers indeed, but thoſe of the ſame Nature and Quality; utterly refuſing them of a contrary. Like Inſtances might be produc'd in the other Tribes of Inſects; it being perpetual in all, if not hinder'd or impriſon'd, electively to lay their *Eggs* in Places where they are ſeldom loſt or miſcarry, and where they have a Supply of Nouriſhment for their Young ſo ſoon as they are hatch'd, and need it: Whereas ſhould they ſcatter them careleſly and indifferently in any Place, the greateſt Part of the Young would in all Likelihood periſh ſoon after their Excluſion for want of Food, and ſo their Numbers continually decreaſing, the whole Species in a few Years would be in danger to be loſt: Whereas no ſuch thing, I dare ſay, hath happened ſince the firſt Creation.

It is here very remarkable, that thoſe Inſects, for whoſe Young Nature hath not made proviſion of ſufficient Suſtenance, do themſelves gather and lay up in ſtore for them. So for example: The *Bee*, the proper Food of whoſe * *Eulæ* is Honey, or perchance *Erithace*, (which we engliſh *Bee-Bread*) neither of which Viands being any where to be found amaſs'd by Nature in quantities ſufficient for their maintenance, doth her ſelf with unwearied diligence and induſtry, flying from Flower to Flower, collect and treaſure them up.

* Bee-maggot.

To theſe I ſhall now add an Obſervation of Mr. *Lewenhoeck's*, concerning the ſudden growth of ſome ſorts of Inſects, and the reaſon of it.

It is (ſaith he) a wonderful thing, and worthy the Obſervation in Fleſh-Flies, that a Fly-Maggot, in five Days ſpace after it is hatch'd, arrives at its full growth and perfect magnitude. For if to the perfecting of it there were requir'd, ſuppoſe a Month's time or more, (as in ſome other Maggots is needful) it is impoſſible that about the Summer-Solſtice any ſuch Flies ſhould be produc'd, becauſe the Fly-Maggots have no ability to ſearch out any other Food than that wherein they are Placed by their Dams. Now this Food, ſuppoſe it be Fleſh, Fiſh, or the Entrails of Beaſts, lying in the Fields, expos'd to the hot Sun-beams, can laſt but a few Days in caſe and condition to be a fit Aliment for theſe Creatures, but will ſoon be quite parch'd and dry'd up. And therefore the moſt wiſe Creator hath given ſuch a Nature and Temperament to them, that within a very few days they attain to their juſt growth and magnitude. Whereas, on the contrary, other Maggots, who are in no ſuch danger of being ſtraitned for Food, continue a whole Month or more before they give over to eat, and ceaſe to grow. He proceeds further to tell us, that ſome of theſe *Fly-Maggots* which he fed daily with freſh Meat, he brought to perfection in four days time; ſo that he conceives that in the heat of Summer the *Eggs* of a *Fly*, or the *Maggots* contain'd in them, may in leſs than a Month's ſpace run thro' all their changes, and come to perfect Flies, which may themſelves lay *Eggs* again.

Secondly, I ſhall take notice of the various ſtrange Inſtincts of Animals; which will neceſſarily demonſtrate, that they are directed to Ends unknown to them, by a wiſe Superintendent. As, 1. That all Creatures ſhould know how to defend themſelves, and offend their Enemies; where their natural Weapons are ſituate, and how to make uſe of them. A *Calf* will ſo manage his Head as tho' he would puſh with his Horns even before they ſhoot. A *Boar* knows the uſe of his Tuſhes; a *Dog* of his Teeth; a Horſe of his Hoofs; a *Cock* of his Spurs; a *Bee* of her Sting; a Ram will butt with his Head, yea tho' he be brought up tame, and never ſaw that Manner of Fighting. Now, why another Animal which hath no Horns ſhould not make a Shew of puſhing, or no Spurs, of ſtriking with his Legs, and the like, I know not, but that every Kind is providentially directed to the Uſe of its proper and natural Weapons. 2. That thoſe Animals that are weak, and have neither Weapons nor Courage to fight, are for the moſt part created ſwift of Foot or Wing, and ſo being naturally timorous, are both willing and able to ſave themſelves by Flight. 3. That Poultry, Partridge, and other Birds, ſhould at the firſt Sight know Birds of Prey, and make Sign of it by a peculiar Note of their Voice to their Young, who preſently thereupon hide themſelves: That the Lamb ſhould acknowledge the Wolf its Enemy, though it had never ſeen one before, as is taken for granted by moſt Naturaliſts, and may, for ought I know, be true, argues the Providence of Nature, or more truly the God of Nature, who, for their Preſervation, hath put ſuch an Inſtinct into them. 4. That young Animals, as ſoon as they are brought forth, ſhould know their Food: As for Example; ſuch as are nouriſhed with Milk preſently find their way to the Paps, and ſuck at them; whereas none of thoſe that are not deſign'd for that Nouriſhment ever offer to ſuck, or ſeek out any ſuch Food. Again, 5. That ſuch Creatures as are whole-footed, or Fin-toed, *viz.* ſome Birds, and Quadrupeds, are naturally directed to go into the Water, and ſwim there, as we ſee *Ducklings*, tho' hatch'd and led by a Hen, if ſhe brings them to the Brink of a River or Pond of Water, they preſently leave her, and in they go, tho' they never ſaw any ſuch Thing done before; and tho' the Hen clucks and calls, and doth what ſhe can to keep them out: This *Pliny* takes Notice of, *Hiſt. Nat. lib.* 10. *cap.* 55. in theſe Words, ſpeaking of Hens: *Super omnia eſt Anatum Ovis ſubditis atque excluſis admiratio, primo non planè agnoſcentis fœtum: mox incertos incubitus ſollicitè convocantis: Poſtremo lamenta circa piſcinæ ſtagna, mergentibus ſe pullis naturâ duce.* So that we ſee every Part in Animals is fitted to its Uſe, and the Knowledge of this Uſe put into them: For neither do any Sort of Web-footed Fowls live conſtantly upon the Land, or fear to enter the Water, nor any Land-Fowl ſo much as attempt to ſwim there.

6. Birds of the ſame Kind make their Neſts of the ſame Material, laid in the ſame Order, and exactly of the ſame Figure; ſo that by the Sight of the Neſt one may certainly know what Bird it belongs to. And this they do, tho' living in diſtant Countries, and tho' they never ſaw, nor could ſee any Neſt made, that is, tho' taken out of the Neſt and brought up by Hand; neither were any of the ſame Kind ever obſerv'd to make a different Neſt, either for Matter or Faſhion. This, together with the curious and artificial Contexture of ſuch Neſts, and their Fitneſs and Convenience for the Reception, Hatching, and Cheriſhing the

Eggs and *Young* of their reſpective Builders, (which we have before taken notice of) is a great Argument of a Superior Author of their and other Natures, who hath endu'd them with theſe Inſtincts, whereby they are as it were acted and driven to bring about Ends which themſelves aim not at, (ſo far as we can diſcern) but are directed to; for (as *Ariſtole* obſerves) *οὔτε τέχνῃ, οὔτε ζητήσαντα, οὔτε βουλευσάμενα ποιεῖ*, *They act not by Art, neither do they enquire, neither do they deliberate about what they do.* And therefore, as Dr. *Cudworth* ſaith well, they are not Maſters of that Wiſdom according to which they act, but only paſſive to the Inſtincts and Impreſſes thereof upon them. And indeed to affirm, that brute Animals do all theſe things by a Knowledge of their own, and which themſelves are Maſters of, and that without Deliberation and Conſultation, were to make them to be endued with a moſt perfect Intellect, far tranſcending that of Humane Reaſon: Whereas it is plain enough, that Brutes are not above Conſultation, but below it; and that theſe Inſtincts of Nature in them, are nothing but a kind of Fate upon them.

The Migration of Birds from an hotter to a colder Country, or a colder to an hotter, according to the Seaſons of the Year, as their Nature is, I know not how to give an account of, it is ſo ſtrange and admirable. What moves them to ſhift their Quarters? You will ſay, the Diſagreeableneſs of the Temper of the Air to the Conſtitution of their Bodies, or Want of Food.

But how come they to be directed to the ſame Place yearly, though ſometimes but a little Iſland, as the *Soland Gooſe* to the *Baſſe* of *Edinburgh Frith*, which they could not poſſibly ſee, and ſo it could have no Influence upon them that way? The Cold or the Heat might poſſibly drive them in a right Line from either, but that they ſhould impel Land-Birds to venture over a wide Ocean, of which they can ſee no End, is ſtrange and unaccountable: One would think that the Sight of ſo much Water, and preſent Fear of Drowning, ſhould overcome the Senſe of Hunger, or Diſagreeableneſs of the Temper of the Air. Beſides, how come they to ſteer their Courſe aright to their ſeveral Quarters, which before the Compaſs was invented was hard for a Man himſelf to do, they being not able, as I noted before, to ſee them at that Diſtance? Think we that the *Quails*, for inſtance, could ſee quite croſs the *Mediterranean Sea?* And yet, it's clear, they fly out of *Italy* into *Africk*, lighting many times on Ships in the Midſt of the Sea, to reſt themſelves when tired and ſpent with flying. That they ſhould thus ſhift Places, is very convenient for them, and accordingly we ſee they do it; which ſeems to be impoſſible they ſhould, unleſs themſelves were endued with Reaſon, or directed and acted by a ſuperior intelligent Cauſe.

The like may be ſaid of the Migration of divers Sorts of Fiſhes: As for Example; the *Salmon*, which from the Sea yearly aſcends up a River ſometimes 400 or 500 Miles, only to caſt their Spawn, and ſecure it in Banks of Sand, for the Preſervation of it 'till the Young be hatch'd or excluded, and then return to Sea again. How theſe Creatures when they have been wandring a long time in the wide Ocean, ſhould again find out and repair to the Mouths of the ſame Rivers, ſeems to me very ſtrange, and hardly accountable, without recourſe to Inſtinct, and the Direction of a Superiour Cauſe. That Birds, ſeeing they have no Teeth for the Maſtication and Preparation of their Food, ſhould for the more convenient Comminution of it in their Stomachs or Gizzards, ſwallow down little Pebble-ſtones, or other hard Bodies, and becauſe all are not fit or proper for that uſe, ſhould firſt try them in their Bills, to feel whether they be rough or angular, for their turns; which if they find them not to be, they reject them. When theſe by the working of the Stomach are worn ſmooth, or too ſmall for their uſe, they avoid them by ſiege, and pick up others. That theſe are of great uſe to them for the grinding of their Meat, there is no doubt. And I have obſerv'd in Birds that have been kept up in Houſes, where they could get no Pebbles, the very Yolks of their Eggs have changed colour, and become a great deal paler, than theirs who have had their liberty to go abroad.

Beſides, I have obſerved in many Birds, the Gullet, before its Entrance into the Gizzard, to be much dilated, and thick ſet, or as it were granulated, with a Multitude of Glandules, each whereof was provided with its excretory Veſſel, out of which, by an eaſy preſſure, you might ſqueeze a Juice or Pap, which ſerved for the ſame Uſe which the *Saliva* doth in Quadrupeds; that is, for the Macerating and Diſſolution of the Meat into a Chyle. For that the *Saliva*, notwithſtanding its Inſipidneſs, hath a notable Virtue of macerating and diſſolving Bodies, appears by the Effects it hath in killing of Quickſilver, fermenting of Dough like Leaven or Yeaſt, taking away Warts, and curing other cutaneous Diſtempers; ſometimes exulcerating the Jaws, and rotting the Teeth.

Give me leave to add one Particular more concerning Birds, which ſome may perchance think too homely and indecent to be mentioned in ſuch a Diſcourſe as this; yet becauſe it is not below the Providence of Nature, and deſigned for Cleanlineſs, and ſome great Men have thought it worth the obſerving, I need not be aſham'd to take notice of it; that is, that in young Birds that are fed in the Neſt, the Excrement that is avoided at one time is ſo viſcid, that it hangs together in a great Lump, as if it were incloſed in a Film, ſo that it may eaſily be taken up, and carried away by the old Bird in her Bill. Beſides, by a ſtrange Inſtinct, the young Bird elevates her hinder Parts ſo high, for the moſt part, that ſhe ſeldom fails to caſt what comes from her clear over the Side of the Neſt. So we ſee here is a double Proviſion made to keep the

Neſt clean, which, if it were defiled with Ordure, the Young Ones muſt neceſſarily be utterly marred and ruined. 7. The *Bee*, a Creature of the loweſt Forms of Animals, ſo that no Man can ſuſpect it to have any conſiderable Meaſure of Underſtanding, or to have Knowledge of, much leſs to aim at, any End, yet makes her Combs and Cells with that Geometrical Accuracy, that ſhe muſt needs be acted by an Inſtinct implanted in her by the wiſe Author of Nature: For firſt, ſhe plants them in a perpendicular Poſture, and ſo cloſe together, as with Conveniency they may, beginning at the Top, and working downwards, that ſo no Room may be loſt in the Hive, and that ſhe may have eaſy Acceſs to all the Combs and Cells. Beſides, the Combs being wrought double, that is, with Cells on each Side, a common Bottom, or Partition-Wall, could not in any other Site have ſo conveniently, if at all, received or contained the Honey. Then ſhe makes the particular Cells moſt Geometrically and Artificially, as the famous Mathematician *Pappus* demonſtrates in the Preface to his third Book of *Mathematical Collections*. Firſt of all, (ſaith he, ſpeaking of the Cells) it is convenient that they be of ſuch Figures as may cohere one to another, and have common Sides, elſe there would be empty Spaces left between them to no Uſe, but to the weakening and ſpoiling of the Work, if any Thing ſhould get in there. And therefore, though a round Figure be moſt capacious for the Honey, and moſt convenient for the *Bee* to creep into, yet did ſhe not make choice of that, becauſe then there muſt have been triangular Spaces left void. Now there are only three rectilineous and ordinate Figures which can ſerve to this Purpoſe; and inordinate, or unlike ones, muſt have been not only leſs elegant and beautiful, but unequal. [Ordinate Figures are ſuch as have all their Sides, and all their Angles equal.] The three Ordinate Figures are, *Triangles*, *Squares*, and *Hexagons*; for the Space about any Point may be fill'd up either by ſix equilateral *Triangles*, or four *Squares*, or three *Hexagons*; whereas three *Pentagons* are too little, and three *Heptagons* too much. Of theſe three, the *Bee* makes uſe of the *Hexagon*, both becauſe it is more capacious than either of the other, provided they be of equal Compaſs, and ſo equal Matter ſpent in the Conſtruction of each: And Secondly, Becauſe it is moſt commodious for the Bee to creep into: And Laſtly, Becauſe in the other Figures, more Angles and Sides muſt have met together at the ſame Point, and ſo the Work could not have been ſo firm and ſtrong. Moreover, the Combs being double, the Cells on each Side the Partition are ſo order'd, that the Angles on one Side inſiſt upon the Centers of the Bottoms of the Cells on the other Side, and not Angle upon or againſt Angle; which alſo muſt needs contribute to the Strength and Firmneſs of the Work. Theſe Cells ſhe fills with Honey for her Winter Proviſion, and curiouſly cloſes them up with Covers of

Wax, that keep the included Liquor from ſpilling, and from external Injuries; as Mr. *Boyle* truly obſerves, *Treatiſe of Final Cauſes, p.* 169. Another Sort of *Bee*, I have obſerved, may be called the *Tree-Bee*, whoſe Induſtry is admirable in making Proviſion for her young. Firſt, ſhe digs round Vaults or Burrows [*Cuniculos*] in a rotten or decay'd Tree, of a great length; in them ſhe builds or forms her cylindrical Neſt or Caſes reſembling Cartrages, or a very narrow Thimble, only in proportion longer, of Pieces of Roſe or other Leaves, which ſhe ſhares off with her Mouth, and plats and joins cloſe together by ſome glutinous Subſtance. Theſe Caſes ſhe fills with a red Pap, of a thinner Conſiſtence than an Electuary, of no pleaſant Taſte, which where ſhe gathers, I know not: And which is moſt remarkable, ſhe forms theſe Caſes, and ſtores them with this Proviſion, before ſhe hath any young one hatch'd, or ſo much as an Egg laid: For on the Top of the Pap ſhe lays one Egg, and then cloſes up the Veſſel with a Cover of Leaves. The encloſ'd Egg ſoon becomes an *Eula*, or Maggot, which feeding upon the Pap till it comes to its full Growth, changes to a *Nympha*, and after comes out a Bee. Another Inſect noted for her ſeeming Prudence, in making Proviſion for the Winter, propoſed by *Solomon* to the Sluggard for his Imitation, is the *Ant*, which (as all Naturaliſts agree) hoards up Grains of Corn againſt the Winter for her Suſtenance:

And is reported by ſome to [*] bite off the *Germen* of them, leſt they ſhould ſprout by the Moiſture of the Earth; which I look upon as a mere Fiction: Neither ſhould I be forward to credit the former Relation, were it not for the Authority of the *Scripture*, becauſe I could never obſerve any ſuch ſtoring up of Grain by our Countrey-Ants.

[*] Plin. l. 11. c. 30.

Yet there is a Quadruped taken notice of even by the Vulgar, for laying up in ſtore Proviſion for the Winter; that is, the *Squirrel*, whoſe Hoards of Nuts are frequently found, and pillaged by them.

The *Beaver* is by credible Perſons, Eye-witneſſes, affirm'd to build him Houſes for Shelter and Security in Winter-time. See Mr. *Boyle* of *Final Cauſes*, *p.* 173.

Beſides theſe I have mentioned, an hundred others may be found in Books relating eſpecially to Phyſick, as, that *Dogs*, when they are ſick, ſhould vomit themſelves by eating Graſs: That *Swine* ſhould refuſe Meat ſo ſoon as they feel themſelves ill, and ſo recover by Abſtinence: That the Bird *Ibis* ſhould teach Men the way of adminiſtring Clyſters, *Plin. lib.* 8. *cap.* 27. The wild *Goats* of *Dictamus* for drawing out of Darts, and healing Wounds: The *Swallow* the Uſe of *Celandine* for repairing the Sight, *&c. ibid.* Of the Truth of which, becauſe I am not fully ſatisfied, I ſhall make no Inference from them.

Thirdly, I ſhall remark the Care that is taken for the Preſervation of the Weak, and ſuch as are expoſed to the Injuries, and preventing the Encreaſe of ſuch as are noiſome and hurtful: For as it is a Demonſtration of the Divine Power and Magnificence to create ſuch Variety of Animals, not only great but ſmall, not only ſtrong and couragious, but alſo weak and timorous; ſo is it no leſs Argument of his Wiſdom to give to theſe Means, and the Power and Skill of uſing them, to preſerve themſelves from the Violence and Injuries of thoſe. That of the weak ſome ſhould dig Vaults and Holes in the Earth, as *Rabbets*, to ſecure themſelves and their Young; others ſhould be arm'd with hard Shells; others with Prickles, the reſt that have no ſuch Armature, ſhould be endued with great Swiftneſs or Pernicity: And not only ſo, but ſome alſo have their Eyes ſtand ſo prominent, as the *Hare*, that they can ſee as well behind as before them, that ſo they may have their Enemy alway in their Eye; and long, hollow, moveable Ears, to receive and convey the leaſt Sound, or that which comes from far, that they be not ſuddenly ſurprized or taken (as they ſay) Napping. Moreover, it is remarkable, that in this Animal, and in the *Rabbet*, the Muſcles of the Loyns and Hind-legs are extraordinarily large in Proportion to the reſt of the Body, or thoſe of other Animals, as if made on Purpoſe for Swiftneſs, that they may be able to eſcape the Teeth of ſo many Enemies as continually purſue and chaſe them. Add hereto the Length of their Hind-legs, which is no ſmall Advantage to them, as is noted by Dame *Julan Barns*, in an antient Dialogue in Verſe between the Huntſman and his Man; the Man there asks his Maſter, What is the Reaſon, why the Hare when ſhe is near ſpent makes up a Hill? The Maſter anſwers, That Nature hath made the Hinder-legs of the Hare longer than the Fore-legs; by which Means ſhe climbs the Hill with much more eaſe than the Dogs, whoſe Legs are of equal Length, and ſo leaves the Dogs behind her, and many Times eſcapes away clear, and ſaves her Life. This laſt Obſervation, I muſt confeſs my ſelf to have borrowed out of the Papers of my honoured Friend Mr. *John Aubrey*, which he was pleaſed to give me a Sight of.

I might here add much concerning the Wiles and Ruſes, which theſe timid Creatures make uſe of to ſave themſelves, and eſcape their Perſecutors, but that I am ſomewhat diffident of the Truth of thoſe Stories and Relations, I ſhall only aver what my ſelf have ſometimes obſerv'd of a Duck, when cloſely purſued by a Water-Dog; ſhe not only dives to ſave herſelf, (which yet ſhe never does but when driven to an exigent, and juſt ready to be caught, becauſe it is Painful and Difficult to her) but when ſhe comes up again, brings not her whole Body above Water, but only her Bill, and Part of her Head, holding the reſt underneath, that ſo the Dog, who the mean Time turns round and looks about him, may not eſpy her, 'till ſhe have recover'd Breath.

As for *Sheep*, which have no natural Weapons or Means to defend or ſecure themſelves, neither Heels to run, nor Claws to dig; they are deliver'd into the Hand, and committed to the Care and Tuition of Man, and ſerving him for divers Uſes, are nouriſhed and protected by him; and ſo enjoying their Beings for a Time, by this Means propagate and continue their Species: So that there are none diſtitute of ſome Means to preſerve themſelves, and their Kind; and theſe Means ſo effectual, that notwithſtanding all the Endeavours and Contrivances of Man and Beaſt to diſtroy them, there is not to this Day one *Species* loſt of ſuch as are mention'd in Hiſtories, and conſequently and undoubtedly neither of ſuch as were at firſt created

Then for Birds of Prey, and rapacious Animals, it is remarkable what *Ariſtotle* obſerves, That they are all ſolitary, and go not in Flocks, *Γαμψωιύχων οὐδὲν ἀγελαῖον.* No Birds of Prey are gregarious. Again, that ſuch Creatures do not greatly multiply, *τῶν γαμψωνύχων ὀλιγοτόκα πάντα.* They for the moſt Part breeding and bringing forth but one or two, or at leſt, a few Young Ones at once: Whereas they that are feeble and timorous are generally Multiparous; or, if they bring forth but few at once, as *Pigeons*, they compenſate that by their often breeding, *viz.* every Month but two throughout the Year; by this Means providing for the Continuation of their Kind. But for the Security of theſe rapacious Birds, it is worthy the noting, that becauſe

cauſe a Prey is not always ready, but perhaps they may fail of one ſome Days, Nature hath made them patient of a long *inedia*, and beſides, when they light upon one, they gorge themſelves ſo therewith, as to ſuffice for their Nouriſhment for a conſiderable Time.

Fourthly, I ſhall note the exact fitneſs of the Parts of the Bodies of Animals to every one's Nature and Manner of Living. A notable Inſtance of which we have in the *Swine*, a Creature well known, and therefore what I ſhall obſerve of it is obvious to every Man. His proper and natural Food being chiefly the Roots of Plants, he is provided with a long and ſtrong Snout; long, that he might thruſt it to a ſufficient Depth into the Ground, without offence to his Eyes; ſtrong and conveniently formed for the rooting and turning up the Ground. And beſides, he is endued with a notable Sagacity of Scent, for the finding out ſuch Roots as are fit for his Food. Hence in *Italy*, the uſual Method for finding and gathering of *Trufles*, or ſubterraneous Muſhromes, (called by the *Italians Tartuſali*, and in *Latin Tubera terræ*) is, by tying a Cord to the Hind-leg of a Pig, and driving him before them into ſuch Paſtures as uſually produce that Kind of Muſhrome, and obſerving where he ſtops and begins to root, and there digging, they are ſure to find a *Trufle*; which when they have taken up, they drive away the Pig to ſearch for more. So I have myſelf obſerved, that in Paſtures where there are *Earth-nuts* to be found up and down in ſeveral Patches, tho' the Roots lie deep in the Ground, and the ſtalks be dead long before and quite gone, the Swine will by their Scent eaſily find them out, and root only in thoſe Places where they grow.

This rooting of the Hog in the Earth, calls to mind another Inſtance of like Nature, that is the *Porpeſſe*, which, as his *Engliſh* Name *Porpeſſe*, i. e. * *Porc peſce*, imports, reſembles the Hog, both in the Strength of his Snout, and alſo in the Manner of getting his Food by rooting. For we found the Stomach of one we deſſected, full of *Sand-Eels*, or *Launces*, which for the moſt Part lie deep in the Sand, and cannot be gotten but by rooting or digging there. We have ſeen the Country People in *Cornwall*, when the Tide was out, to fetch them out of the Sand with Iron-Hooks thruſt down under them, made for that Purpoſe.

* Swine-fiſh.

Furthermore, that very Action for which the Swine is abominated, and look'd upon as an unclean and impure Creature, namely wallowing in the Mire, is deſign'd by Nature for a very good End and Uſe, *viz.* not only to cool his Body, for the fair Water would have done that as well, nay, better, for commonly the Mud and Mire in Summer-time is warm; but alſo to ſuffocate and deſtroy Lice, Fleas, and other noiſom and importunate Inſects, that are troubleſome and noxious to him. For the ſame Reaſon do all the Poultry-kind, and divers other Birds, bask themſelves in the Duſt in Summer-time and hot Weather, as is obvious to every one to obſerve.

2. A Second and no leſs remarkable Inſtance, I ſhall produce, out of Dr, *More's Antidote againſt Atheiſm*, lib. 2. cap. 10. in a poor and contemptible Quadruped, the *Mole*.

First of all, (ſaith he) her Dwelling being under Ground, where nothing is to be ſeen, Nature hath ſo obſcurely fitted her with Eyes, that Naturaliſts can ſcarcely agree, whether ſhe hath any Sight at all or no. [In our Obſervation, *Moles* have perfect Eyes, and Holes for them through the Skin, ſo that they are outwardly to be ſeen by any that ſhall diligently ſearch for them; tho' indeed they are exceeding ſmall, not much bigger than a great Pin's-head.] But for amends, what ſhe is capable of for her Defence and Warning of Danger, ſhe has very eminently conferr'd upon her; for ſhe is very quick of hearing, [doubtleſs her ſubterraneous Vaults are like Trunks to convey any Sound a great Way.] And then her ſhort Tail and ſhort Legs, but broad Fore-feet armed with ſharp Claws, we ſee by the Event to what purpoſe they are, ſhe ſo ſwiftly working her ſelf under Ground, and making her Way ſo faſt in the Earth, as they that behold it cannot but admire it. Her Legs therefore are ſhort, that ſhe need dig no more than will ſerve the meer Thickneſs of her Body: And her Fore-feet are broad, that ſhe may ſcoup away much Earth at a Time: And ſhe has little or no Tail, becauſe ſhe courſes it not on the Ground like a *Rat* or *Mouſe*, but lives under the

Earth, and is fain to dig her ſelf a Dwelling there; and ſhe making her way through ſo thick an Element, which will not eaſily yield as the Water and Air do; it had been dangerous to draw ſo long a Train behind her; for her Enemy might fall upon her Rear, and fetch her out before ſhe had perfected and got full Poſſeſſion of her Works: Which being ſo, what more palpable Argument of Providence than ſhe?

Another Inſtance in Quadrupeds might be the *Tamandua*, or *Ant-Bear*, deſcribed by *Marcgrave* and *Piſo*, who ſaith of them, that they are Night-walkers, and ſeek their Food by Night. Being kept tame, they are fed with Fleſh, but it muſt be minced ſmall, becauſe they have not only a ſlender and ſharp Head and Snout, but alſo a narrow and toothleſs Mouth; their Tongue is like a great Lute-ſtring (as big as a Gooſe-quil) round, and in the greater Kind (for their are two *Species*) more than two Foot long, and therefore lies doubled in a Chanel between the lower Parts of the Cheeks. This when hungry they thruſt forth, being well moiſtned, and lay upon the Trunks of Trees, and when it is cover'd with *Ants*, ſuddenly draw it back into their Mouths; if the *Ants* lie ſo deep that they cannot come at them, they dig up the Earth with their long and ſtrong Claws, wherewith for that Purpoſe their Fore-feet are armed. So we ſee how their Parts are fitted for this Kind of Diet, and no other; for the catching of it, and for the eating of it, it requiring no Comminution by the Teeth, as appears alſo in the *Chamælion*, which is another Quadrupid that imitates the *Tamandua* in this Property of darting out the Tongue to a great Length, with wonderful Celerity; and for the ſame Purpoſe too of catching of Inſects.

Beſides theſe Quadrupeds, there are a whole Genus of *Birds*, called *Pici Marcii*, or *Woodpeckers*, that in like Manner have a Tongue which they can ſhoot forth to a very great Length, ending in a ſharp ſtiff bony Rib, dented on each Side; and at Pleaſure thruſt it deep into the Holes, Clefts, and Crannies of Trees, to ſtab and draw out *Coſſi*, or any other Inſects lurking there, as alſo into Ant-hills, to ſtrike and fetch out the *Ants* and their *Eggs*. Moreover, they have ſhort, but very ſtrong Legs, and their Toes ſtand two forwards, two backwards, which Diſpoſition (as *Aldrovandus* well notes) Nature, or rather the Wiſdom of the Creator, hath granted to *Woodpeckers* becauſe it is very convenient for the climbing of Trees, to which alſo conduces the ſtiffneſs of the Feathers of their Tails, and their bending downward, whereby they are fitted to ſerve as a Prop for them to lean upon, and bear up the Bodies. As for the *Chamælion*, he imitates the *Woodſpite*, not only in the Make, Motion, and Uſe of his Tongue for ſtriking *Ants*, *Flies*, and other Inſects; but alſo in the Site of his Toes, whereby he is wonderfully qualified to run upon Trees, which he doth with that Swiftneſs, that one would think he flew, whereas upon the Ground he walks very clumſily and ridiculouſly. A full Deſcription of the outward and inward Parts of this Animal, may be ſeen at the End of *Panarolus*'s *Obſervat.* It is to be noted, that the *Chamælion*, tho' he hath Teeth, uſes them not for chewing his Prey, but ſwallows it immediately.

I ſhall add two Inſtances more in Birds, and thoſe are,

1. The *Swallow*, whoſe proper Food is ſmall Beetles, and other Inſects flying about in the Air; as we have found by diſſecting the Stomachs both of Old ones and Neſtlings: Which is wonderfully fitted for the catching of theſe Animalcules; for ſhe hath long Wings, and a forked Tail, and ſmall Feet, whereby ſhe is as it were made for ſwift Flight, and enabled to continue long upon the Wing, and to turn nimbly in the Air: and ſhe hath alſo an extraordinary wide Mouth, ſo that it's very hard for any Inſect that comes in her Way to eſcape her. It is thought to be a Sign of Rain, when this Bird flies low near to the Ground; in which there may be ſome Truth; becauſe the inſects which ſhe hunts may at ſuch Times, when the ſuperior Air is charged with Vapours, have a Senſe of it, and deſcend near the Earth. Hence, when there are no more Inſects in the Air, as in Winter-time, thoſe Birds do either abſcond, or betake themſelves into hot Countries.

2. The *Colymbi*, or *Douchers*, or *Loons*, whoſe Bodies are admirably fitted and conformed for diving under Water, being cover'd with a very thick Plumage, and the *Superficies* of their Feathers ſo ſmooth and ſlippery, that the Water cannot penetrate, or moiſten them; whereby their Bodies are defended from the Cold, the Water being kept at a diſtance, and ſo poiſed, that by a light Impulſe they may eaſily aſcend in it. Then their Feet are ſituate in the hindmoſt Part of their Body, whereby they are enabled, ſhooting their Feet backwards, and ſtriking the Water upwards, to plunge themſelves down into it with great Facility, and likewiſe to move forwards therein. Then their Legs are made flat and broad, and their Feet cloven into Toes with appendant Membranes on each ſide, by which Configuration they eaſily cut the Water, and are drawn forward, and ſo take their Stroke backwards; and beſides, I conceive, that by means of this Figure, their Feet being mov'd to the Right and Left-hand, ſerve them as a Rudder to enable them to turn under Water: For ſome conceive, that they ſwim eaſier under Water than they do above it. How they raiſe themſelves up again, whether their Bodies emerge of themſelves by their Lightneſs, or whether by ſtriking againſt the Bottom, in Manner of a Leap, or by ſome peculiar Motion of their Legs, I cannot determine. That they dive to the Bottom is clear; for that in the Stomachs both of the greater and leſſer Kinds we found Graſs and other Weeds, and in the leſ-

ſer kind nothing elſe; though both prey upon Fiſh. Their Bills alſo are made ſtreight and ſharp for the eaſier cutting of the Water, and ſtriking their Prey. Could we ſee the Motions of their Legs and Feet in the Water, then we ſhould better comprehend how they aſcend, deſcend, and move to and fro; and diſcern, how wiſely and artificially their Members are formed and adapted to thoſe Uſes.

II. In *Birds*, all the Members are moſt exactly fitted for the Uſe of Flying. Firſt, The Muſcles, which ſerve to move the Wings, are the greateſt and ſtrongeſt, becauſe much Force is required to the Agitation of them; the underſide of them is alſo made Concave, and the upper Convex, that they may be eaſily lifted up, and more ſtrongly beat the Air, which by this means doth more reſiſt the Deſcent of their Body downward. Then the Trunk of their Body doth ſomewhat reſemble the Hull of a Ship; the Head, the Prow, which is for the moſt part ſmall, that it may the more eaſily cut the Air, and make way for their Bodies; the Train ſerves to ſteer, govern, and direct their Flight; and however it may be held erect in their ſtanding, or walking, yet is directed to lie almoſt in the ſame Plain with their Backs, or rather a little inclining when they fly. That the Train ſerves to ſteer and direct their Flight, and turn their Bodies like the Rudder of a Ship, is evident in the *Kite*, who, by a light turning of his Train, moves his Body which way he pleaſes. *Iidem videntur artem gubernandi docuiſſe caudæ flexibus, in Cœlo monſtrante natura quod opus eſſet in profundo*, Plin. Lib. 10. c. 10. *They ſeem to have taught Men the Art of ſteering a Ship by the Flexures of their Tails; Nature ſhewing in the Air what was needful to be done in the Deep.* And it's notable that *Ariſtotle* truly obſerves, that whole-footed Birds, and thoſe that have long Legs, have for the moſt part ſhort Tails; and therefore whilſt they fly, do not, as others, draw them up to their Bellies, but ſtretch them at length backwards, that they may ſerve to ſteer and guide them inſtead of Tails. Neither doth the Tail ſerve only to direct and govern the Flight, but alſo partly to ſupport the Body, and keep it even; wherefore, when ſpread, it lies parallel to the Horizon, and ſtands not perpendicular to it, as Fiſhes do. Hence Birds that have no Tails, as ſome Sorts of *Colymbi*, or Duckers, fly very inconveniently with their Bodies almoſt erect.

To this I ſhall add further, That the Bodies of Birds are ſmall in Compariſon of Quadrupeds, that they may more eaſily be ſupported in the Air during their Flight; which is a great Argument of Wiſdom and Deſign: Elſe why ſhould not we ſee Species of *Pegaſi*, or Flying-Horſes, of *Griffins*, of *Harpies*, and an Hundred more, which might make a Shift to live well enough, notwithſtanding they could make no Uſe of their Wings: Beſides, their Bodies are not only ſmall, but of a broad Figure, that the Air may more reſiſt their Deſcents; they are alſo hollow and light; nay, their very Bones are light: For though thoſe of the Legs and Wings are ſolid and firm, yet have they ample Cavities, by which Means they become more rigid and ſtiff; it being demonſtrable, that a hollow Body is more ſtiff and inflexible than a ſolid one of equal Subſtance and Matter. Then the Feathers alſo are very light, yet their Shafts hard and ſtiff, as being either empty, or filled with a light and ſpungy Subſtance, and their Webs are not made of continued Membranes; for then, had a Rupture by any Accident been made in them, it could not have been conſolidated, but of two Series of numerous *Pumulæ*, or contiguous Filaments, furniſhed all along with Hooks on each ſide, whereby catching hold on one another, they ſtick faſt together; ſo that when they are ruffled, or diſcompoſed, the Bird with her Bill can eaſily preen them, and reduce them to their due Poſition again. And for their firmer Cohæſion, the wiſe and bountiful Author of Nature hath provided and placed on the Rump two Glandules, having their excretory Veſſels, round which grow Feathers in Form of a Pencil, to which the Bird turning her Head, catches hold upon them with her Bill, and a little compreſſing the Glandules, ſqueezes out and brings away therewith an oily Pap, or Liniment, moſt fit and proper for the Inunction of the Feathers, and cauſing their little Filaments more ſtrongly to cohere. And is not this ſtrange and admirable, and argumentative of Providence, that there ſhould be ſuch an Unguent, or Pap, prepared, ſuch an open Veſſel to excern it into, to receive and retain it; that the Bird ſhould know where it is ſituate, and how, and to what Purpoſes to uſe it? And becauſe the Bird is to live many Years, and the Feathers in time would, and muſt neceſſarily be worn and ſhatter'd, Nature hath made Proviſion for the caſting and renewing of them Yearly. Moreover, thoſe large Bladders, or Membranes, extending to the Bottoms of the Bellies of Birds, into which the Breath is received, conduce much to the alleviating of the Body, and facilitating the Flight: For the Air received into theſe Bladders, is by the Heat of the Body extended into twice, or thrice, the Dimenſions of the External, and ſo muſt needs add a Lightneſs to the Body. And the Bird when ſhe would deſcend, may either compreſs this Air by the Muſcles of the *Abdomen*, or expire as much of it as may enable her to deſcend ſwifter, or ſlower, as ſhe pleaſes. I might add the Uſe of the Feathers in cheriſhing and keeping of the Body warm; which, the Creature being of ſmall Bulk, muſt needs ſtand in great Stead againſt the Rigour of the Cold. And for this reaſon we ſee, that Water-Fowls, which were to ſwim, and ſit long upon the cold Water, have their Feathers very thick ſet upon their Breaſts and Bellies, and beſides a plentiful Down there growing, to fence againſt the Cold of the Water, and to keep off its immediate Contact.

That the Tails of all Birds in general do not conduce to their turning to the Right and Left, according to the common Opinion, but rather for their Aſcent and Deſcent, ſome modern Philoſophers have obſerved and proved by Experiment; for that if you pluck off, for inſtance, a Pigeon's Tail, ſhe will nevertheleſs, with equal Facility, turn to and fro: Which upon ſecond Thoughts, and further Conſideration, I grant to be true, in Birds whoſe Tails are pointed, and end in a right Line: But in thoſe that have forked Tails, Autopſy convinceth us, that it hath this uſe; and therefore they pronounce too boldly of all in general. For it is manifeſt to Sight, that the fork'd-tail'd Kite, by turning her Train ſideways, elevating one Horn, and depreſſing the other, turns her whole Body. And doubtleſs the Tail hath the ſame uſe in *Swallows*, who make the moſt ſudden Turns in the Air of any Birds, and have all of them forked Tails.

III. As for *Fiſhes*, their Bodies are long and ſlender, or elſe thin, for the moſt Part, for their more eaſie ſwimming and dividing the Water. The Wind-bladder, wherewith moſt of them are furniſhed, ſerves to poiſe their Bodies, and keep them equiponderant to the Water, which elſe would ſink to the Bottom, and lie groveling there, as hath, by breaking the Bladder, been experimentally found. By the Contraction and Dilatation of this Bladder, they are able to raiſe, or ſink themſelves at Pleaſure, and continue in what Depth of Water they liſt.

The Fins, made of griſtly Spokes, or Rays, connected by Membranes, ſo that they may be contracted, or extended like Womens Fans, and furniſhed with Muſcles for Motion, ſerve partly for Progreſſion, but chiefly to hold the Body upright; which appears in that when they are cut off, it wavers to and fro, and ſo ſoon as the Fiſh dies, the Belly turns upwards. The great Strength by which Fiſhes dart themſelves forward with incredible Celerity, like an Arrow out of a Bow, lies in their Tails, their Fins mean time, leſt they ſhould retard their Motion, being held cloſe to their Bodies. And therefore almoſt the whole Muſculous Fleſh of the Body is beſtow'd upon the Tail and Back, and ſerves for the Vibration of the Tail, the Heavineſs and Corpulency of the Water requiring a great Force to divide it.

In *Cetaceous* Fiſhes, or, as the *Latins* call them, * Sea-Beaſts, the Tail hath a different Poſition from what it hath in all other Fiſhes; for whereas in theſe it is erected perpendicular to the Horizon, in them it lies parallel thereto, partly to ſupply the Uſe of the hinder Pair of Fins which theſe Creatures lack, and partly to raiſe and depreſs the Body at pleaſure. For it being neceſſary that theſe Fiſhes ſhould frequently aſcend to the Top of the Water to breath, or take in and let out the Air, it was fitting and convenient that they ſhould be provided with an Organ to facilitate their Aſcent and Deſcent as they had Occaſion. And as for their turning of their Bodies in the Water, they

* Belluæ Marinæ.

muſt perform that as Birds do, by the Motion of one of their Fins, while the other is quieſcent. It is no leſs remarkable in them, that their whole Body is incompaſſed round with a copious Fat, which our Fiſhermen call the *Blubber*, of a great Thickneſs; which ſerves partly to poize their Bodies, and render them equiponderant to the Water; partly to keep off the Water at ſome Diſtance from the Blood, the immediate Contact whereof would be apt to chill it; and partly alſo for the ſame Uſe that Clothes ſerve us, to keep the Fiſh warm, by reflecting the hot Steams of the Body, and ſo redoubling the Heat, as we have before-noted. For we ſee, by Experience, that fat Bodies are nothing near ſo ſenſible of the Impreſſions of Cold as lean. And I have obſerved fat Hogs to have lain abroad in the open Air, upon the cold Ground, in Winter Nights; whereas the lean ones have been glad to creep into their Cotes, and lie upon Heaps to keep themſelves warm.

I might here take Notice of thoſe Amphibious Creatures, which we may call Aquatic Quadrupeds (though one of them there is that hath but two Feet, *viz.* the *Manati*, or Sea-Cow) the *Beaver*, the *Otter*, the *Phoca*, or Sea-Calf, the *Water-Rat*, and the *Frog*, the Toes of whoſe Feet are joined by Membrances, as in Water-Fowls, for ſwimming; and who have very ſmall Ears, and Ear-holes, as the Cetaceous Fiſhes have, for hearing in the Water.

To this Head belongs the adapting of the Parts that miniſter to Generation in the Sexes one to another; and in Creatures that nouriſh their Young with Milk, the Nipples of the Breaſt to the Mouth and Organs of Suction; which he muſt needs be wilfully blind and void of Senſe, that either diſcerns not, or denies to be intended and made one for the other. That the Nipples ſhould be made ſpungy, and with ſuch Perforations, as to admit Paſſage to the Milk when drawn, otherwiſe to retain it; and the Teeth of the Young either not ſprung, or ſo ſoft and tender, as not to hurt the Nipples of the Dam, are Effects and Arguments of Providence and Deſign.

A more full Deſcription of the Breaſts and Nipples I meet with, in a Book of that ingenious Anatomiſt and Phyſician, *Antonius Nuck*, entitled, *Adenographia Curioſa*, cap. 2. He makes the Breaſts to be nothing but Glandules of that Sort they call *Conglomeratæ*, made up of an infinite Number of little Knots, or Kernels, each whereof hath its Excretory Veſſel, or Lactiferous Duct; three, or four, or five of theſe preſently meet, and join into one ſmall Trunk; in like Manner do the adjacent Glandules meet and unite; ſeveral of theſe leſſer Trunks, or Branches, concurring, make up an Excretory Veſſel of a notable Bigneſs, like to that of the *Pancreas*, but not ſo long, yet ſufficiently large, to receive and retain a good Quantity of Milk; which before it enters the Nipple, is again contracted, and ſtraitned to that Degree, that it will ſcarce admit a ſmall Briſtle. Who now can be ſo impudent as to deny, that all this was contrived and deſigned purpoſely to retain the Milk, that it ſhould not flow out of itſelf, but eaſily be drawn out by Preſſure and Suction; or to affirm that this fell out accidentally, than which there could not have been a more ingenious Contrivance for the Uſe to which it is imploy'd, invented by the Wit of Man?

To this Head of the Fitneſs of the Parts of the Body to the Creature's Nature, and Manner of Living, belongs that Obſervation of *Ariſtotle*, *τῶν ὀρνίθων ὅσα μὲν γαμψώνυχα σαρκοφάγα πάντα.* Such Birds as have crooked Beaks and Talons, are all Carnivorous; and ſo of Quadrupeds, *καρχαρόδοντα*, *Carnivora omnia.* All that have Serrate Teeth, are Carnivorous. This Obſervation holds true concerning all *European* Birds; but I know not but that *Parrots* may be an Exception to it. Yet it is remarkable, that ſuch Birds as are Carnivorous have no Gizzard, or Muſculous, but a Membranous Stomach, that Kind of Food needing no ſuch Grinding, or Comminution as Seeds do, but being torn into Strings, or ſmall Flakes, by the Beak, may be eaſily concocted by a Membranous Stomach.

To the Fitneſs of all the Parts and Members of Animals to their reſpective Uſes, may alſo be referred another Obſervation of the ſame *Ariſtotle*, Πάντα τὰ ζῶα ἀρτίους ἔχει πόδας. All Animals have even Feet, not more on one ſide than another; which, if they had, would either hinder their walking, or hang by not only uſeleſs, but alſo burthenſome. For though a Creature might make a limping ſhift to hop, ſuppoſe with three Feet, yet nothing ſo conveniently or ſteddily to walk, or run, or indeed to ſtand. So that we ſee, Nature hath made choice of what is moſt fit, proper and uſeful. They have alſo not only an even number of Feet, anſwering by Pairs one to another, which is as well decent as convenient, but thoſe too of an equal length, I mean the ſeveral Pairs; whereas were thoſe on one ſide longer than they on the other, it would have cauſed an inconvenient halting or limping in their going.

I ſhall mention but one more Obſervation of *Ariſtotle*, that is, Πτηνὸν μόνον ȣ̓δὲν, there is no Creature only volatile, or no flying Animal, but hath Feet as well as Wings, a Power of walking or creeping upon the Earth; becauſe there is no Food, or at leaſt not ſufficient Food, for them to be had always in the Air; or if in hot Countries we may ſuppoſe there is, the Air being never without ſtore of Inſects flying about in it, yet could ſuch Birds take no reſt, for having no Feet, they could not pearch upon Trees; and if they ſhould alight upon the Ground, they could by no means raiſe themſelves any more, as we ſee thoſe Birds which have but ſhort Feet, as the *Swift* and *Martinet* with difficulty do. Beſides, they would want means of Breeding, having no were to lay their Eggs, to ſit, hatch, or brood their Young. As for the Story of the *Manucodiata*, or *Bird of Paradiſe*, which in the former Ages was generally received and accepted for true, even by the Learned, it is now diſcover'd to be a Fable, and rejected and exploded by all Men: Thoſe Birds being well known to have Legs and Feet as well as others, and thoſe not ſhort, ſmall, nor feeble ones, but ſufficiently great and ſtrong, and arm'd with crooked Talons, as being the Members of Birds of Prey.

It is alſo very remarkable, That all flying Inſects ſhould be covered with ſhelly Scales, like Armour, partly to ſecure them from external Violence, from Injuries by Blows and Preſſures: Partly to defend their tender Muſcles from the Heat of the Sun-beams, which would be apt to parch and dry them up, being of ſmall Bulk; partly alſo to reſtrain the Spirits, and to prevent their Evaporation.

I ſhall now add another Inſtance of the Wiſdom of Nature, or rather the God of Nature, in adapting the Parts of the ſame Animal one to another, and that is the proportioning the Length of the Neck to that of the Legs. For ſeeing Terreſtrial Animals, as well Birds as Quadrupeds, are endued with Legs, upon which they ſtand, and wherewith they transfer themſelves from Place to Place, to gather their Food, and for other Conveniences of Life, and ſo the Trunk of their Body muſt needs be elevated above the Superficies of the Earth, ſo that they could not conveniently either gather their Food, or Drink, if they wanted a Neck, therefore Nature hath not only furniſhed them therewith, but with ſuch on one as is commenſurable to their Legs, except here the Elephant, which hath indeed a ſhort Neck; for the exceſſive

Weight of his Head and Teeth, which to a long Neck would have been unſupportable, but is provided with a Trunk, wherewith, as with a Hand, he takes up his Food and Drink, and brings it to his Mouth. I ſay, the Necks of Birds and Quadrupeds are commenſurate to their Legs, ſo that they which have long Legs have long Necks, and they that have ſhort Legs, ſhort ones, as is ſeen in the *Crocodile*, and all *Lizards*; and thoſe that have no Legs, as they do not want Necks, ſo neither have they any, as *Fiſhes*. This Equality between the Length of the Legs and Neck, is eſpecially ſeen in Beaſts that feed conſtantly upon Graſs, whoſe Necks and Legs are always very near equal; very near, I ſay, becauſe the Neck muſt neceſſarily have ſome Advantage, in that it cannot hang perpendicularly down, but muſt incline a little; Moreover, becauſe this Sort of Creatures muſt needs hold their Heads down in an Inclining Poſture, for a conſiderable time together, which would be very laborious and painful for the Muſcles; therefore on each ſide the Ridge of the Vertebres of the Neck, Nature hath placed an ἀπονεύρωσις, or nervous Ligament of a great Thickneſs and Strength, apt to ſtretch and ſhrink again as Need requires, and void of Senſe, extending from the Head (to which, and the next Vertebres of the Neck, it is faſtned at that end) to the middle Vertebres of the Back (to which it is knit at the other) to aſſiſt them to ſupport the Head in that Poſture, which *Aponeuroſis* is taken notice of by the Vulgar by the Name of *Fixfax*, or *Pack-wax*, or *White-leather*. It is alſo very obſervable in Fowls that wade in the Water, which having long Legs, have alſo Necks anſwerably long: Only in theſe too there is an Exception, exceeding worthy to be noted; for ſome Water-Fowl, which are *Palmipeds*, or whole-footed, have very long Necks, and yet but ſhort Legs, as *Swans* and *Geeſe*, and ſome *Indian* Birds; wherein we may obſerve the admirable Providence of Nature. For ſuch Birds as were to ſearch and gather their Food, whether Herbs or Inſects, in the bottom of Pools and deep Waters, have long Necks for that purpoſe, though their Legs, as is moſt convenient for Swimming, be but ſhort. Whereas there are no Land-Fowl to be ſeen with ſhort Legs, and long Necks, but all have their Necks in Length commenſurate to ther Legs. This Inſtance is the more conſiderable, becauſe the Atheiſts uſual Flam will not here help them out. For (ſay they) there were many Animals of diſproportionate Parts, and of abſurd and uncouth Shapes produced at firſt in the Infancy of the World; but becauſe they could not gather their Food, or perform other Functions neceſſary to maintain Life, they ſoon periſhed, and were loſt again. For theſe Birds, we ſee, can gather their Food upon Land conveniently enough, notwithſtanding the Length of their Necks. For example, Geeſe graze upon Commons, and can feed themſelves fat upon Land: Yet is there not one Land-Bird, which hath its Neck thus diſproportionate to its Legs; nor one

Water one neither, but ſuch as are diſtined by Nature in ſuch manner as we have mentioned to ſearch and gather their Food. For Nature makes not a long Neck to no purpoſe.

Laſtly, Another Argument of Providence and Council relating to Animals, is the various kinds of Voices the ſame Animal uſes on divers occaſions, and to different purpoſes. Hen-Birds, for Example, have a peculiar ſort of Voice when they would call the Male; which is ſo eminent in *Quails*, that it is taken Notice of by Men, who by counterfeiting this Voice with a Quail-pipe, eaſily draw the Cocks into their Snares. The common Hen, all the while ſhe is broody, ſits, and leads her Chickens, uſes a Voice which we call *Clocking*. Another ſhe employs when ſhe calls her Chickens to partake of any Food ſhe hath found for them; upon hearing whereof, they ſpeedily run to her. Another when upon ſight of a Bird of Prey, or apprehenſion of any Danger, ſhe would ſcare them, bidding them, as it were, to ſhift for themſelves, whereupon they ſpeedily run away, and ſeek Shelter among Buſhes, or in the thick Graſs, or elſewhere diſperſing themſelves far and wide. Theſe Actions do indeed neceſſarily infer Knowledge and Intention of, and Direction to the Ends and Uſes to which they ſerve, not in the Birds themſelves, but in a ſuperiour Agent, who hath put an Inſtinct in them of uſing ſuch a Voice upon ſuch an occaſion; and in the Young, of doing that upon hearing of it, which by Providence was intended. Other Voices ſhe hath when angry, when ſhe hath laid an Egg, when in Pain, or great Fear, all ſignificant, which may more eaſily be accounted for, as being Effects of the ſeveral Paſſions of Anger, Grief, Fear, Joy: Which yet are all argumentative of Providence, intending their ſeveral Significations and Uſes.

I might alſo inſtance in Quadrupeds; ſome of which have as great a Diverſity of Voices as Hens themſelves; and all of them ſignificant; for Example, That common domeſtick Animal the *Cat*, as is obvious to every one to obſerve, and therefore I ſhall not ſpend Time to mention Particulars.

Object. But againſt the Uſes of ſeveral Bodies I have inſtanced in, that refer to Man, it may be objected, That theſe Uſes were not deſigned by Nature in the Formation of the Things; but that the Things were by the Wit of Man accommodated to thoſe Uſes.

To which I anſwer, with Dr. *More*, in the *Appendix* to his *Antidote againſt Atheiſm*, That the ſeveral uſeful Dependencies of this Kind, (*viz.* of *Stones*, *Timber*, and *Metals*, for building of Houſes or Ships, the *Magnet* for Navigation, *&c.* Fire for melting of Metals, and forging of Inſtruments for the Purpoſes mentioned) we only find, not make them. For whether we think of it or no, it is, for Example, manifeſt, that Fuel is good to continue Fire, and Fire to melt Metals, and Metals to make Inſtruments to build Ships and Houſes, and ſo on. Wherefore it being true, that there is ſuch a ſubordinate Uſefulneſs in the Things themſelves that are made to our Hand, it is but Reaſon in us to impute it to ſuch a Cauſe, as was aware of the Uſefulneſs and Serviceableneſs of its own Works. To which I ſhall add, that ſince we find Materials ſo fit to ſerve all the Neceſſities and Conveniencies, and to exerciſe and employ the Wit and Induſtry of an intelligent and active Being; and ſince there is ſuch an one created that is endued with Skill and Ability to uſe them, and which by their Help is enabled to rule over and ſubdue all inferior Creatures, but without them had been left neceſſitous, helpleſs, and obnoxious to Injuries above any other; and ſince the Omniſcient Creator could not but know all the Uſes, to which they might and would be employed by Man, to them that acknowledge the Being of a Deity; it is little leſs than a Demonſtration, that they were created intentionally, I do not ſay only, for thoſe Uſes.

Methinks, by all this Proviſion for the Uſe and Service of Man, the Almighty interpretatively ſpeaks to him in this manner: I have now placed thee in a ſpacious and well-furniſh'd World; I have endued thee with an Ability of underſtanding what is beautiful and proportionable, and have made that which is ſo, agreeable and delightful to thee; I have provided thee with Materials whereon to exerciſe and employ thy Art and Strength; I have given thee an excellent Inſtrument, the Hand, accommodated to make uſe of them all; I have diſtinguiſhed the Earth into Hills and Vallies, and Plains, and Meadows, and Woods; all theſe Parts, capable of Culture and Improvement by thy Induſtry; I have committed to thee for thy Aſſiſtance in thy Labours of Plowing, and Carrying, and Drawing, and Travel, the laborious Ox, the patient Aſs, and the ſtrong and ſerviceable Horſe; I have created a Multitude of Seeds for thee to make choice out of them, of what is moſt pleaſant to thy Taſte, and of moſt wholeſome and plentiful Nouriſhment; I have alſo made great Variety of Trees, bearing Fruit both for Food and Phyſick, thoſe too capable of being meliorated and improved by Tranſplantation, Stercoration, Inciſion, Pruning, Watering, and other Arts and Devices. Till and manure thy Fields, ſow them with thy Seeds; extirpate noxious and unprofitable Herbs; guard them from the Invaſions and Spoil of Beaſts; clear and fence in thy Meadows and Paſtures; dreſs and prune thy Vines, and ſo rank and diſpoſe them as is moſt ſuitable to the Climate; plant thee Orchards, with all Sorts of Fruit-Trees, in ſuch Order as may be moſt beautiful to the Eye, and moſt comprehenſive of Plants; Gardens for culinary Herbs, and all Kinds of Salletting; for delectable Flowers, to gratify the Eye with their agreable Colours and Figures, and thy Scent with their fragrant Odors; for Odoriferous and Ever-green Shrubs and Suffrutices; for Exotick and Medicinal Plants of all Sorts, and diſpoſe them in that comely Order, as may be both pleaſant to behold, and commodious for

Acceſs. I have furniſhed thee with all Materials for Building, as Stone, and Timber, and Slate, and Lime, and Clay and Earth, whereof to make Bricks and Tiles; deck and beſpangle the Country with Houſes and Villages convenient for thy Habitation, provided with Out-houſes and Stables for the harbouring and ſhelter of thy Cattle, with Barnes and Granaries for the reception, and cuſtody, and ſtoring up thy Corn and Fruits. I have made thee a ſociable Creature, Ζῶον πολιτικὸν, for the Improvement of thy Underſtanding by Conference, and Communication of Obſervations and Experiments; for mutual help, and aſſiſtance, and defence; build thee large Towns and Cities with ſtreight and well-paved Streets, and elegant Rows of Houſes, adorned with magnificent Temples for my Honour and Worſhip, with beautiful Palaces for thy Princes and Grandees, with ſtately Halls for Publick Meetings of the Citizens and their ſeveral Companies, and the Seſſions of the Court of Judicature; beſides Publick Portico's and Aquæducts. I have implanted in thy Nature a deſire of ſeeing ſtrange and foreign, and finding out unknown Countries, for the improvement and advance of thy Knowledge in *Geography*, by obſerving the Bays, and Creeks, and Havens, and Promontories, the Out lets of Rivers, the Situation of the Maritime Towns and Cities, the Longitude and Latitude, *&c.* of thoſe Places: In *Politicks*, by noting their Government, their Manners, Laws, and Cuſtoms, their Diet and Medicines, their Trades and Manufactures, their Houſes and Buildings, their Exerciſes and Sports, *&c.* In *Phyſiology*, or Natural Hiſtory, by ſearching out their Natural Rarities, the Productions both of Land and Water, what *Species* of Animals, Plants, and Minerals, of Fruits and Drugs are to be found here, what Commodities for Bartering and Permutation, whereby thou mayeſt be enabled to make large Additions to Natural Hiſtory, to advance thoſe other Sciences, and to benefit and enrich thy Country by increaſe of its Trade and Merchandize. I have given thee Timber and Iron to build the Hulls of Ships, tall Trees for Maſts, Flax and Hemp for Sails, Cables, and Cordage, for Rigging. I have armed thee with Courage and Hardneſs to attempt the Seas, and traverſe the ſpacious Plains of that liquid Element. I have aſſiſted thee with a Compaſs, to direct thy Courſe when thou ſhalt be out of all Ken of Land, and have nothing in View but Sky and Water. Go thither for the Purpoſes before-mentioned, and bring Home what may he uſeful and beneficial to thy Country in general, or thy ſelf in particular.

I perſwade my ſelf, that the bountiful and gracious Author of Man's Being and Faculties, and all Things elſe, delights in the Beauty of his Creation, and is well pleaſed with the Induſtry of Man, in adorning the Earth with beautiful Cities and Caſtles; with pleaſant Villages and Country-Houſes; with regular Gardens and Orchards, and Plantations of all Sorts of Shurbs, and Herbs, and Fruits, for Meat, Medicine, or moderate Delight; with ſhady Woods and Groves, and Walks ſet with Rows of elegant Trees; *with Paſtures cloathed with Flocks, and Valleys covered over with Corn*, and Meadows burthened with Graſs, and whatever elſe differenceth a civil and well cultivated Region, from a barren and diſſolate Wilderneſs.

If a Country thus planted and adorn'd, thus poliſhed and civilized, thus improved to the height by all manner of Culture for the Support and Suſtenance, and convenient Entertainment of innumerable multitudes of People, be not to be preferred before a barbarous and inhoſpitable *Scythia*, without Houſes, without Plantations, without Corn-fields or Vineyards, where the roving *Hords* of the ſavage and truculent Inhabitants, transfer themſelves from place to place in Waggons, as they can find Paſture and Forrage for their Cattle, and live upon Milk, and Fleſh roaſted in the Sun, at the Pomels of their Saddles; or a rude and unpoliſhed *America*, peopled with ſlothful and naked *Indians*, inſtead of well-built Houſes, living in pitiful Huts and Cabbins, made of Poles ſet end-ways; then ſurely the brute Beaſts Condition, and manner of Living, to which, what we have mention'd doth nearly approach, is to be eſteem'd better than Man's, and Wit and Reaſon was in vain beſtowed on him.

Laſtly, I might draw an Argument of the admirable Art and Skill of the Creator and Compoſer of them, from the incredible Smalneſs of ſome of thoſe natural and enlevined Machines, the Body of Animals.

Any Work of Art of extraordinary Fineneſs and Subtlety, be it but a ſmall Engine or Movement, or a Curious carved or turned Work of Ivory or Metals, ſuch as thoſe Cups turned of Ivory by *Oſwaldus Nerlinger* of *Suevia*, mention'd by *Joan. Faber*, in his Expoſitions of *Recchus* his *Mexican* Animals, which all had the perfect form of Cups, and were gilt with a Golden Border about the Brim, of that wonderful ſmalneſs, that *Faber* himſelf put a thouſand of them into an excavated Pepper-corn; and when he was weary of the Work, and yet had not filled the Veſſel, his Friend, *John Carlus Schad*, that ſhewed them him, put in four hundred more. Any ſuch Work, I ſay, is beheld with admiration, and purchaſed at a great Rate, and treaſured up as a ſingular Rarity in the *Muſæums* and Cabinets of the Curious, and as ſuch is one of the firſt things ſhewed to *Travellers* and *Strangers*. But what are theſe for their fineneſs and parvity (for which alone, and their Figure, they are conſiderable) to thoſe Minute Machines endued with life and motion, I mean, the Bodies of thoſe *Animalcula*, not long ſince diſcovered in *Pepper-water*, by Mr. *Leuenhoek*, of *Delft* in *Holland*, (whoſe Obſervations were confirmed and improved by our Learned and Worthy

Country-man Dr. *Robert Hook*) who tells us; That ſome of his Friends (whoſe Teſtimonials he deſired) did affirm, That they had ſeen 10000, others 30000, others 45000 little living Creatures, in a Quantity of Water no bigger than a Grain of Millet; and yet he made it his Requeſt to them, that they would only juſtify (that they might be within compaſs) half the number that they believed each of them ſaw in the Water. From the greateſt of theſe Numbers he infers, that there will be 8280000 of theſe living Creatures ſeen in one drop of Water; which number (ſaith he) I can with Truth affirm, I have diſcerned. This (proceeds he) doth exceed belief: But I do affirm, if a large Grain of Sand were broken into 8000000, of equal Parts, one of theſe would not exceed the bigneſs of one of thoſe Creatures. Dr. *Hook* tells us, That after he had diſcovered vaſt multitudes of thoſe exceeding ſmall Creatures which Mr. *Leuenhoek* had deſcribed, upon making uſe of other Lights and Glaſſes, he not only magnified thoſe he had diſcovered to a very great bigneſs, but diſcovered many other ſorts very much ſmaller than them he firſt ſaw, and ſome of them ſo exceeding ſmall, that Millions of Millions might be contain'd in one drop of Water. If *Pliny*, conſidering ſuch Inſects as were known to him, and thoſe were none but what were viſible to the naked Eye, was moved to cry out, That the Artifice of Nature was no where more conſpicuous than in theſe. And again, *In his tam parvis atque tam* *nullis quæ ratio, quanta vis, quam inextricabilis perfectio?* And again, *Rerum natura nuſquam magis quàm in minimis tota eſt*, Hiſt. Nat. l. 11. c. 1. What would he have ſaid, if he had ſeen Animals of ſo ſtupendous ſmallneſs, as I have mention'd? How would he have been rapt into an Extaſie of Aſtoniſhment and Admiration?

Again: If conſidering the Body of a Gnat, (which by his own confeſſion is none of the leaſt of Inſects) he could make ſo many admiring Queries, *Where hath Nature diſpoſed ſo many Senſes in a Gnat? Ubi viſum prætendit? Ubi guſtatum applicavit? Ubi odoratum inſeruit? Ubi verò truculentam illam & portione maximam vocem ingeneravit? Quâ ſubtilitate pennas adnexuit? Prælongavit pedum crura? Diſpoſuit jejunam caveam uti alvum? Avidam ſanguinis & potiſſimum humani ſitim accendit? Telum verò perfodiendo tergori quo ſpiculavit ingenio? Atque ut in capaci, cùm cerni non poſſit exilitas, ità reciproca geminavit arte, ut fodiendo acuminatum pariter ſorbendoque fiſtuloſum eſſet.* Which Words ſhould I tranſlate, would loſe of their Emphaſis and Elegancy; if, I ſay, he could make ſuch Queries about the Members of a Gnat, what may we make; and what would he in all likelihood have made, had he ſeen theſe incredibly ſmall living Creatures? How would he have admired the immenſe Subtilty (as he phraſes it) of their Parts? For to uſe Dr. *Hook*'s Words in his *Microſcopium*, p. 103. If theſe

Creatures be ſo exceeding ſmall, what muſt we think of their Muſcles and other Parts? Certain it is, that the Mechaniſm by which Nature performs the Muſcular Motion, is exceeding ſmall and curious, and to the performance of every Muſcular Motion, in greater Animals at leaſt, there are not fewer diſtinct parts concerned than many Millions of Millions, and theſe viſible through a Microſcope.

Uſe. Let us then conſider the Works of God, and obſerve the Operations of his Hands: Let us take notice of, and admire his infinite Wiſdom and Goodneſs in the Formation of them: No Creature in this ſublunary World is capable of ſo doing, beſides Man, and yet we are deficient herein: We content our ſelves with the Knowledge of the Tonges, on a little Skill in Philology, or Hiſtory perhaps, and Antiquity, and neglect that which to me ſeems more material, I mean, Natural Hiſtory, and the Works of the Creation: I do not diſcommend or derogate from thoſe other Studies: I ſhould betray mine own Ignorance and Weakneſs ſhould I do ſo; I only wiſh they might not altogether juſtle out, and exclude this. I wiſh that this might be brought in faſhion among us; I wiſh Men would be ſo equal and civil, as not to diſparage, deride, and vilifie thoſe Studies which themſelves skill not of, or are not converſant in; no Knowledge can be more pleaſant than this, none that doth ſo ſatisfie and feed the Soul; in compariſon whereto that of Words and Phraſes ſeem to me inſipid and jejune. That Learning (ſaith a wiſe and obſervant Prelate) which conſiſts only in the Form and Pedagogy of Arts, or the critical Notions upon Words and Phraſes, hath in it this intrinſical imperfection, that it is only ſo far to be eſteemed, as it conduceth to the Knowledge of Things, being in itſelf but a kind of Pedantry, apt to infect a Man with ſuch odd Humours of Pride, and Affectation, and Curioſity, as will render him unfit for any great Employment. Words being but the Images of Matter, to be wholly given up to the ſtudy of theſe, what is it but *Pygmalion*'s Frenzy, to fall in Love with a Picture or Image? As for *Oratory*, which is the beſt skill about Words, that hath by ſome wiſe Men been eſteem'd, but a voluntary Art, like to Cookery, which ſpoils wholeſome Meats, and helps unwholeſome, by the variety of Sauces, ſerving more to the Pleaſure of Taſt, than the Health of the Body.

It may be (for ought I know, and as ſome Divines have thought) part of our Buſineſs and Employment in Eternity, to contemplate the Works of God, and give him the Glory of his Wiſdom, Power, and Goodneſs, manifeſted in the Creation of them. I am ſure it is part of the Buſineſs of a Sabbath-day, and the Sabbath is a Type of that Eternal Reſt; for the Sabbath ſeems to have been firſt inſtituted for a Commemoration of the Works of the Creation, from which God is ſaid to have reſted upon the Seventh-Day.

It is not likely that Eternal Life ſhall be a torpid and unactive State, or that it ſhall conſiſt only in an uninterrupted and endleſs Act of Love; the other Faculties ſhall be employed as well as the Will, in Actions ſuitable to, and perfective of their Natures; eſpecially the Underſtanding, the Supreme Faculty of the Soul, which chiefly differenceth us from brute Beaſts, and makes us capable of Virtue and Vice, of Rewards and Puniſhments, ſhall be buſied and employed in contemplating the Works of God, and obſerving the Divine Art and Wiſdom, manifeſted in the Structure and Compoſition of them; and reflecting upon their Great Architect the Praiſe and Glory due to him. Then ſhall we clearly ſee to our great Satisfaction and Admiration, the Ends and Uſes of theſe Things, which here were either too ſubtle for us to penetrate and diſcover, or too remote and unacceſſible for us to come to any diſtinct View of, *viz.* the Planets, and fixed Stars; thoſe illuſtrious Bodies, whoſe Contents and Inhabitants, whoſe Stores and Furniture we have here ſo longing a Deſire to know, as alſo their mutual Subſerviency to each other. Now the Mind of Man being not capable at once to advert to more than one Thing, a particular View and Examination of ſuch an innumerable Number of vaſt Bodies, and the great

Multitude of *Species*, both of animate and inanimate Beings, which each of them contains, will afford Matter enough to exerciſe and employ our Minds, I do not ſay, to all Eternity, but to many Ages, ſhould we do nothing elſe.

Let it not ſuffice us to be Book-learned, to read what others have written, and to take upon Truſt more Falſhood than Truth: But let us our ſelves examine Things as we have Opportunity, and converſe with Nature as well as Books. Let us endeavour to promote and encreaſe this Knowledge, and make new Diſcoveries, not ſo much diſtruſting our own Parts, or deſpairing of our own Abilities, as to think that our Induſtry can add nothing to the Invention of our Anceſtors, or correct any of their Miſtakes. Let us not think that the Bounds of Science are fixed like *Hercules*'s Pillars, and inſcribed with a *Ne plus ultra*. Let us not think we have done, when we have learn'd what they have delivered to us. The Treaſurers of Nature are inexhauſtible. Here is Employment enough for the vaſteſt Parts, the moſt indefatigable Induſtries, the happieſt Opportunities, the moſt prolix and undiſturb'd Vacancies. *Multa venientis ævi populus ignota nobis ſciet: Multa ſeculis tunc futuris, cum memoria noſtri exoleverit reſervantur. Puſilla res mundus eſt, niſi in eo quod quærat omnis mundus habeat.* Seneca Nat. Quæſt. lib. 7. cap. 31. *The People of the next Age ſhall know many Things unknown to us: Many are*

are reſerved for Ages then to come, when we ſhall be quite forgotten, no Memory of us remaining. The World would be a pitiful ſmall Thing indeed, if it did not contain enough for the Enquiries of the whole World. Yet, and again, *Epiſt.* 64. *Multum adhuc reſtat Operis, multùmque reſtabit, nec ulli nato poſt mille ſæcula præcludetur occaſio aliquid adhuc adjiciendi. Much Work ſtill remains, and much will remain, neither to him that ſhall be born after a thouſand Ages, will Matter be wanting for new Additions to what hath already been invented.* Much might be done, would we but endeavour, and nothing is inſuperable to Pains and Patience. I know that a new Study at firſt, ſeems very vaſt, intricate, and difficult; but after a little Reſolution and Progreſs, after a Man becomes a little acquainted, as I may ſo ſay, with it, his Underſtanding is wonderfully cleared up and enlarged, the Difficulties vaniſh, and the Thing grows eaſy and familiar. And for our Encouragement in this Study, obſerve what the Pſalmiſt ſaith, *Pſal.* 111. 2. *The Works of the Lord are great, ſought out of all them that have Pleaſure therein.* Which though it be principally ſpoken of the Works of Providence, yet may as well be verified of the Works of the Creation. I am ſorry to ſee ſo little Account made of real Experimental Philoſophy in this * Univerſity; and that thoſe ingenious Sciences of the Mathematicks are ſo much neglected by us: And therefore do earneſtly

* *Cambridge*, where the Author lived, at the firſt writing of this.

neſtly exhort thoſe that are young, eſpecially Gentlemen, to ſet upon theſe Studies, and take ſome Pains in them. They may poſſibly invent ſomething of eminent Uſe and Advantage to the World; and one ſuch Diſcovery would abundantly compenſate the Expence and Travel of one Man's whole Life. However, it is enough to maintain and continue what is already invented: Neither do I ſee what more ingenious and manly Employment they can purſue, tending more to the Satisfaction of their own Minds, and the Illuſtration of the Glory of God, for he is wonderful in all his Works.

But I would not have any Man croſs his natural Genius or Inclinations, or undertake ſuch Methods of Study, as his Parts are not fitted to, or not ſerve thoſe Ends to which his Friends, upon mature Deliberation, have deſigned him; but thoſe who do abound with Leiſure, or who have a natural Propenſion and Genius inclining them thereto; or thoſe who by Reaſon of the Strength and Greatneſs of their Parts, are able to compaſs and comprehend the whole Latitude of Learning.

Neither yet need thoſe who are deſigned to Divinity itſelf, fear to look into theſe Studies, or think they will engroſs their whole Time, and that no conſiderable Progreſs can be made therein, unleſs Men lay aſide and neglect their ordinary Callings, and neceſſary Employments. No ſuch Matter. Our Life is long enough, and we might find Time enough did we husband it well : *Vitam non accepimus brevem, ſed fecimus, nec inopes ejus, ſed prodigi ſumus,* as *Seneca* ſaith, *We have not received a ſhort Life, but have made it ſo; neither do we want Time, but are prodigal of it.* And did but young Men fill up that Time with theſe Studies, which lies upon their Hands, which they are incumbred with, and troubled how to paſs away, much might be done even ſo. I do not ſee, but the Study of true Phyſiology, may be juſtly accounted a proper, or Προπαιδεία Preparative to Divinity. But to leave that, it is a generally received Opinion, that all this viſible World was created for Man; that Man is the End of the Creation; as if there were no other End of any Creature, but ſome way or other to be ſerviceable to Man. This Opinion is as old as *Tully*; for, ſaith he, in his Second Book, De Nat. Deorum. *Principio ipſe Mundus Deorum hominumque cauſâ factus eſt : quæque in eo ſunt omnia ea parata ad fructum hominum & inventa ſunt.* But though this be vulgarly received, yet wiſe Men now-a-days think otherwiſe. Dr. *More* affirms, * *That Creatures are made to enjoy themſelves, as well as to ſerve us; and that it is a groſs Piece of Ignorance and Ruſticity to think otherwiſe.* And in another Place; *This comes only out of Pride and Ignorance, or a haughty Preſumption, becauſe we are encouraged to believe, that, in ſome Senſe, all Things are made for Man; therefore to think that they*

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* *Antidot. Atheiſm,* l. 2. c. 11.

they are not at all made for themſelves. But he that pronounceth this, is ignorant of the Nature of Man, and the Knowledge of Things: For if a good Man be merciful to his Beaſt, then ſurely a good God is bountiful and benign, and takes Pleaſure that all his Creatures enjoy themſelves, that have Life and Senſe, and are capable of Enjoyment.

Thoſe Philoſophers indeed, who hold Man to be the only Creature in this ſublunary World, endued with Senſe and Perception, and that all other Animals are meer Machines or Puppets, have ſome Reaſon to think, That all Things here below were made for Man. But this Opinion ſeems to me too mean, and unworthy the Majeſty, Wiſdom, and Power of God; nor can it well conſiſt with his Veracity, inſtead of a Multitude of Noble Creatures, endued with Life and Senſe, and ſpontaneous Motion, as all Mankind till of late Years believed, and none ever doubted of (ſo that it ſeems we are naturally made to think ſo) to have ſtocked the Earth with divers Sets of *Automata*, without all Senſe and Perception, being wholly acted from without, by the Impulſe of external Objects.

But be this ſo, there are infinite other Creatures without this Earth, which no conſiderate Man can think were made only for Man, and have no other Uſe. For my Part I cannot believe, that all the Things in the World were ſo made for Man, that they have no other Uſe.

For it ſeems to me highly abſurd and unreaſonable, to think that Bodies of ſuch vaſt Magnitude as the fix'd Stars, were only made to twinkle to us; nay, a Multitude of them there are, that do not ſo much as twinkle, being either by reaſon of their Diſtance, or of their Smalneſs, altogether inviſible to the naked Eye, and only diſcoverable by a Teleſcope; and it is likely, perfecter Teleſcopes than we yet have, may bring to light many more; and who knows, how many lie out of the Ken of the beſt Teleſcope that can poſſibly be made? And, I believe, there are many Species in Nature, even in this ſublunary World, which were never yet taken Notice of by Man, and conſequently of no Uſe to him, which yet we are not to think were created in vain; but may be found out by, and of Uſe to thoſe who ſhall live after us in future Ages. But though in this Senſe it be not true, that all Things were made for Man; yet, thus far it is, that all the Creatures in the World may be ſome way or other Uſeful to us, at leaſt to exerciſe our Wits and Underſtandings, in conſidering and contemplating of them, and ſo afford us Subject of admiring and glorifying their and our Maker. Seeing then, we do believe, and aſſert, that all Things were in ſome Senſe made for us, we are thereby oblig'd to make uſe of them for thoſe Purpoſes for which they ſerve us, elſe we fruſtrate this End of their Creation. Now ſome of them ſerve only to exerciſe our Minds: Many others there be, which might probably ſerve us to good Purpoſe, whoſe Uſes are not diſcovered, nor are they ever like to be, without Pains and Induſtry. True it is, many of the greateſt Inventions have been accidentally ſtumbled upon; but not by Men ſupine and careleſs, but buſie and inquiſitive. Some Reproach methinks it is to learned Men, that there ſhould be ſo many Animals in the World, whoſe outward Shape is not yet taken Notice of, or deſcrib'd, much leſs their Way of Generation, Food, Manners, Uſes, obſerved.

The Scripture, *Pſal.* 148. calls upon *the Sun, Moon, and Stars, Fire and Hail, Snow and Vapour, ſtormy Winds and Tempeſts, Mountains and all Hills, fruitful Trees, and all Cedars, Beaſts and all Cattle, creeping Things and flying Fowl,* &c. *to praiſe the Lord.* How can that be? Can ſenſeleſs and inanimate Things praiſe God? Such as are the Sun, and Moon, and Stars. And although Beaſts be advanced higher to ſome Degree of Senſe and Perception; yet being void of Reaſon and Underſtanding, they know nothing of the Cauſes of Things, or of the Author and Maker of themſelves, and other Creatures. All that they are capable of doing, in reference to the praiſing of God, is (as I ſaid before) by affording Matter, or Subject, of praiſing him, to rational and intelligent Beings. So the Pſalmiſt, *Pſal.* xix. 1. *The Heavens declare the Glory of God, and the Firmament ſheweth his Handy-work.* And therefore the *Pſalmiſt,* when he calls upon

Sun, and Moon, and Stars, to praiſe God, doth in effect call upon Men and Angles, and other Rational Beings, to conſider thoſe great Effects of the Divine Power and Wiſdom, their vaſt Dimenſions, their regular Motions and Periods, their admirable Diſpoſition and Order, their Eminent Ends and Uſes in illuminating and enlivening the Planets, and other Bodies about them, and their Inhabitants, by their comfortable and cheriſhing Light, Heat, and Influences, and to give God the Glory of his Power, in making ſuch Great and Illuſtrious Bodies, and of his Wiſdom and Goodneſs in ſo placing and diſpoſing of them, ſo moving them regularly and conſtantly, without claſhing, or interfering, one with another, and enduing them with ſuch excellent Vertues and Properties, as to render them ſo ſerviceable and beneficial to Man, and all other Creatures about them.

The like may be ſaid of Fire, Hail, Snow, and other Elements and Meteors, of Trees, and other Vegetables, of Beaſts, Birds, Inſects, and all Animals; when they are commanded to praiſe God, which they cannot do by themſelves; Man is commanded to conſider them particularly, to Obſerve and take Notice of their curious Structure, Ends, and Uſes, and give God the Praiſe of his Wiſdom, and other Attributes therein manifeſted.

And therefore thoſe who have Leiſure, Opportunity, and Abilities, to contemplate and conſider any of theſe Creatures, if they do it not, do as it were rob God of ſome Part of his Glory, in neglecting or ſlighting ſo eminent a Subject of it, and wherein they might have diſcovered ſo much Art, Wiſdom, and Contrivance.

And it is particularly remarkable, that the Divine Author of this *Pſalm*, amongſt other Creatures, calls upon Inſects alſo to praiſe God; which is as much as to ſay, ye Sons of Men, neglect none of his Works, thoſe which ſeem moſt vile and contemptible; there is Praiſe belongs to him for them. Think not that any Thing he hath vouchſafed to create, is unworthy thy Cognizance, to be ſlighted by thee. It is Pride and Arrogance, or Ignorance and Folly, in thee ſo to think. There is a greater Depth of Art and Skill in the Structure of the meaneſt Inſect, than thou art able for to fathom, or comprehend.

The Wiſdom, Art, and Power of Almighty God, ſhines forth as viſibly in the Structure of the Body of the minuteſt Inſect, as in that of a Horſe, or Elephant: Therefore God is ſaid to be, *Maximus in minimis*. We Men eſteem it a more difficult Matter, and of greater Art and Curioſity, to frame a ſmall Watch, than a large Clock: And no Man blames him who ſpent his whole Time in the Conſideration of the Nature and Works of a Bee, or thinks his Subject was too narrow. Let us not then eſteem any thing contemptible, or inconſiderable, or below our notice taking; for this is to derogate from the Wiſdom and Art of the Creator, and to confeſs ourſelves unworthy of thoſe Endowments of Knowledge and Underſtanding which he hath beſtowed on us. Do we praiſe *Dædalus*, and *Archytas*, and *Hero*, and *Callicrates*, and *Albertus Magnus*, and many others which I might mention, for their Cunning in inventing, and Dexterity in framing and compoſing a few dead Engines, or Movements, and ſhall we not admire and magnifie the Great Δημιȣργὸς Κόσμȣ, *Former of the World*, who hath made ſo many, yea, I may ſay, innumerable, rare Pieces, and thoſe too not dead ones, ſuch as ceaſe preſently to move ſo ſoon as the Spring is down; but all living, and themſelves performing their own Motions, and thoſe ſo intricate and various, and requiring ſuch a Multitude of Parts and ſubordinate Machines, that it is incomprehenſible what Art, and Skill, and Induſtry, muſt be employed in the framing of one of them?

I have already noted out of Dr. *Hook*, that to the Performance of every Muſcular Motion, at leaſt in greater Animals, there are not fewer diſtinct Parts concerned, than many Millions of Millions.

Further, from the Conſideration of our own Smallneſs and Inconſiderableneſs, in reſpect of the Greatneſs and Splendor of thoſe glorious heavenly Bodies, the Sun, Moon, and Stars, to which our Bodies bear no proportion at all either in Magnitude, or Luſtre; let us with the Holy *Pſalmiſt* raiſe up our Hearts to magnifie the Goodneſs of God towards us in taking ſuch Notice of us, and making ſuch Proviſion for us, and advancing us ſo highly above all his Works, *Pſal.* viii. 3. *When I conſider the Heavens, the Work of thy Fingers, the Moon and the Stars which thou haſt ordained. What is Man that thou art mindful of him, and the Son of Man that thou viſiteſt him? For thou haſt made him a little lower than the Angels, and haſt crowned him with Glory and Honour,* &c.

But it may be objected, that God Almighty was not ſo ſelfiſh and deſirous of Glory, as to make the World, and all the Creatures therein, only for his own Honour, and to be praiſed by Man. To aſſert this, were, in *Des Cartes*'s Opinion, an abſurd and childiſh Thing, and a Reſembling of God to a proud Man. It is more worthy the Deity, to attribute the Creation of the World, to the Exundation and Overflowing of his tranſcendent and infinite Goodneſs, which is of its own Nature, and in the very Notion of it, moſt free, diffuſive, and communicative.

To this I ſhall anſwer in two Words; Firſt, The Teſtimony of Scripture makes God in all his Actions to intend and deſign his own Glory mainly, *Prov.* xvi. 4. *God made all Things for himſelf.* How! for himſelf? He hath no Need of them: He hath no Uſe of them. No, he made them for the Manifeſtation of his Power, Wiſdom, and Goodneſs, and that he might receive from the Creatures that were able to take Notice thereof, his Tribute of Praiſe, *Pſal.* 50. 14. *Offer unto God Thankſgiving.* And in the next Verſe, *I will deliver thee, and thou ſhalt glorifie me.* And again in the laſt Verſe, *Whoſo offereth Praiſe, glorifieth me.* So Praiſe is called a Sacrifice, and *the Calves of the Lips*, Hoſea xiv. 2. Iſa. xlii. 8. *I am the Lord, that is my Name, and my Glory will I not give to another.* Iſa. xlviii. 11. *And I will not give my Glory to another.* The Scripture calls upon the Heavens, and Earth, and Sun, and Moon, and Stars, and all other Creatures, to praiſe the Lord; that is, by the Mouth of Man, (as I ſhewed before) who is hereby required to take notice of all theſe Creatures, and to admire and praiſe the Power, Wiſdom, and Goodneſs of God, manifeſted in the Creation and Deſignations of them.

Secondly, It is moſt reaſonable that God Almighty ſhould intend his own Glory: For he being infinite in all Excellencies and Perfections, and independent upon any other Being;

nothing can be ſaid or thought of him too Great, and which he may not juſtly challenge as his due; nay, he cannot think too highly of Himſelf, his other Attributes being adequate to his Underſtanding; ſo that, though his Underſtanding be infinite, yet he underſtands no more than his Power can effect, becauſe that is infinite alſo. And therefore it is fit and reaſonable, that he ſhould own and accept the Creatures Acknowledgments and Celebrations of thoſe Virtues and Perfections, which he hath not received of any other, but poſſeſſeth eternally and originally of himſelf. And indeed, (with Reverence be it ſpoken) what elſe can we imagine the ever Bleſſed Deity to delight and take Complacency in for ever, but his own infinite Excellencies and Perfections, and the Manifeſtations and Effects of them, the Works of the Creation, and the Sacrifices of Praiſe and Thanks offered up by ſuch of his Creatures as are capable of conſidering thoſe Works, and diſcerning the Traces and Footſteps of his Power and Wiſdom appearing in the Formation of them; and moreover, whoſe bounden Duty it is ſo to do? The Reaſon why Man ought not to admire himſelf, or ſeek his own Glory, is, becauſe he is a dependent Creature, and hath nothing but what he hath received, and not only dependent, but imperfect; yea, weak and impotent: And yet I do not take Humility in Man to conſiſt in diſowning, or denying any Gift or Ability that is in him, but in a juſt Valuation of ſuch Gifts and Endowments, yet rather thinking too meanly than too highly of them; becauſe Humane Nature is ſo apt to err in running into the other Extreme, to flatter itſelf, and to accept thoſe Praiſes that are not due to it; Pride being an Elation of Spirit upon falſe Grounds, or a Deſire and Acceptance of undue Honour. Otherwiſe, I do not ſee why a Man may not admit, and accept the Teſtimonies of others, concerning any Perfection, Accompliſhment, or Skill, that he is really poſſeſſed of, yet can he not think himſelf to deſerve any Praiſe or Honour for it, becauſe both the Power and the Habit are the Gift of God: And conſidering that one Virtue is counter-balanced by many Vices, and one Skill or Perfection, with much Ignorance and Infirmity.

The End of the Firſt Part.

The SECOND PART of the

WISDOM of GOD

Manifeſted in the

WORKS

OF THE

CREATION.

Particularly in the

I. Whole Body of the Earth.
II. Bodies of Man,
And other Animals.

THE WISDOM of GOD Manifeſted in the WORKS OF THE CREATION.

PART II.

I Proceed now to ſelect ſome particular Pieces of the Creation, and to conſider them more diſtinctly. They ſhall be only Two:

I. The whole Body of the Earth.
II. The Body of Man.

Firſt, The Body of the Earth; and therein I ſhall take Notice of, 1. Its Figure. 2. Its Motion. 3. The Conſtitution of its Parts.

By Earth I here underſtand not the Dry Land, or the Earth contradiſtinguiſhed to Water, or the Earth conſidered as an Element; but the whole *Tarraqueous* Globe, compoſed of Earth and Water.

1. For the *Figure*, I could eaſily demonſtrate it to be Spherical. That the Water, which by Reaſon of its fluidity ſhould, one would think, compoſe it ſelf to a Level, yet doth not ſo, but hath a gibboſe *Superficies*, may to the Eye be demonſtrated upon the Sea. For when two Ships ſailing contrary ways loſe the ſight one of another: Firſt the Keel and Hull diſappear, afterwards the Sails, and if when upon Deck you have perfectly loſt ſight of all, you get up to the Top of the Main-maſt, you may diſcry it again. Now what ſhould take away the ſight of theſe Ships from each other but the gibboſity of the interjacent Water? The roundneſs of the Earth from North to South is demonſtrated from the appearance of Northern Stars above the Horizon, and loſs of the Southern to them that travel Northward; and on the Contrary, the loſs of the Northern, and appearance of the Southern to them that travel Southward. For were the Earth a Plain, we ſhould ſee exactly the ſame Stars where-ever we were placed on that Plain. The roundneſs from Eaſt to Weſt is demonſtrated from *Eclipſes* of either of the great *Luminaries*. For why the ſame *Eclipſe*, ſuppoſe of the *Sun*, which is ſeen to them that live more Eaſterly, when the Sun is elevated ſix Degrees above the Horizon,

ſhould be ſeen to them that live one degree more Weſterly, when the Sun is but five degrees above the Horizon, and ſo lower and lower proportionably to them that live more and more Weſterly, 'till at laſt it appear not at all, no Account can be given, but the globoſity of the Earth. For were the Earth a perfect Plain, the Sun would appear Eclipſed to all that live upon that Plain, if not exactly in the ſame Elevation, yet pretty near it; but to be ſure it would never appear to ſome, the Sun being elevated high above the Horizon; and not at all to others. It being clear then, that the Figure of the Earth is Spherical, let us conſider the Conveniences of this Figure.

1. No Figure is ſo capacious as this, and conſequently, whoſe Parts are ſo well compacted and united, and lie ſo near one to another for mutual Strength. Now the Earth, which is the Baſis of all Animals, and as ſome think, of the whole Creation, ought to be firm, and ſtable, and ſolid, and as much as is poſſible, ſecured from all Ruins and Concuſſions.

2. This Figure is moſt conſonant and agreable to the natural *Nutus*, or Tendency of all heavy Bodies. Now the Earth being ſuch a one, and all its Parts having an equal propenſion, or connivency to the Center, they muſt needs be in greateſt Reſt, and moſt Immoveable when they are all equidiſtant from it. Whereas, were it an Angular Body, all the Angles

would be vaſt and ſteep Mountains, bearing a conſiderable Proportion to the whole bulk, and therefore thoſe Parts being extremely more remote from the Center, than thoſe about the Middle of the Plains, would conſequently preſs very ſtrongly thitherward; and unleſs the Earth were made of Adamant or Marble, in Time the other Parts would give way, 'till all were levelled.

3. Were the Earth an Angular Body, and not round, all the whole Earth would be nothing elſe but vaſt Mountains, and ſo incommodious for Animals to live upon; for the middle Point of every Side would be nearer the Center than any other, and conſequently from that Point, which way ſoever one travelled, would be up Hill, the Tendency of all heavy Bodies being perpendicularly to the Center. Beſides, how much this would obſtruct Commerce is eaſily ſeen: For not only the Declivity of all Places would render them very difficult to be travelled over, but likewiſe the Midſt of every Side being loweſt and neareſt the Center, if there were any Rain, or any Rivers, muſt needs be filled with a Lake of Water, there being no way to diſcharge it, and poſſibly the Water would riſe ſo high, as to overflow the whole *Latus*. But, ſurely, there would be much more danger of the Inundation of whole Countries than now there is, all the Waters falling upon the Earth, by reaſon of its Declivity every Way, eaſily deſcending down to

the common Receptacle the Sea. And theſe Lakes of Water being far diſtant one from another, there could be no Commerce between far remote Countries, but by Land.

4. A Spherical Figure is moſt commodious for *Dinetial* Motion, or Revolution, upon its own *Axis*; for in that, neither can the Medium at all reſiſt the Motion of the Body, becauſe it ſtands not in its way, no Part coming into any Space but what the Precedent left, neither doth one Part of the Superficies move faſter than another: Whereas were it Angular, the Parts about the Angles would find ſtrong reſiſtance from the Air, and thoſe Parts alſo about the Angles would move much faſter than thoſe about the Middle of the Planes, being remoter from the Center than they. It remains therefore that this Figure is the moſt commodious for Motion.

Here I cannot but take Notice of the Folly and Stupidity of the *Epicureans*, who fanſied the Earth to be flat and contiguous to the Heavens on all Sides, and that it deſcended a great way with long Roots; and that the Sun was new made every Morning, and not much bigger than it ſeems to the Eye, and of a flat Figure, and many other ſuch groſs Abſurdities as Children among us would be aſhamed of.

Secondly, I come now to ſpeak of the *Motion* of the *Earth*. That the *Earth* (ſpeaking according to Philoſophical Accurateneſs) doth move both upon its own Poles, and in the *Ecliptick*, is now the received Opinion of the moſt learned and skilful *Mathematicians*. To prove the Diurnal Motion of it upon its Poles, I need produce no other Argument than, *Firſt*, The vaſt Diſproportion in reſpect of Magnitude that is between the Earth and the Heavens; and the great Unlikelihood that ſuch an infinite Number of vaſt Bodies ſhould move about ſo inconſiderable a Spot as the Earth, which in Compariſon with them by the concurrent Suffrages of Mathematicians of both Perſwaſions, is a mere Point, that is, next to nothing. *Secondly*, The immenſe and incredible Celerity of the Motion of the Heavenly Bodies in the ancient *Hypotheſis*. *Thirdly*, Of its Annual Motion in the Ecliptick, the Stations and Retrogradations of the ſuperior Planets are a convincing Argument, there being a clear and facile Account thereof to be given from the mere Motion of the Earth in the *Ecliptick*; whereas in the old *Hypotheſis* no Account can be given, but by the unreaſonable Fiction of *Epicycles*, and contrary Motions; add hereto the great Unlikelihood of ſuch an enormous *Epicycle* as *Venus* muſt deſcribe about the Sun, not under the Sun, as the old Aſtronomers fanſied. About the Sun, I ſay, as appears by its being hid, or eclipſed by it, and by its ſeveral *Phaſes*, like the *Moon*. So that whoſoever doth clearly underſtand both *Hypotheſes*, cannot, I perſwade myſelf, adhere to the Old, and reject the New, without doing ſome Violence to his Faculties.

Againſt this Opinion lie two Objections, *Firſt*, That it is contrary to Senſe, and the common Opinion and Belief of Mankind. *Secondly*, That it ſeemeth contrary to ſome Expreſſions in *Scripture*. To the firſt I Anſwer, That our Senſes are ſometimes miſtaken, and what appears to them is not always in reality ſo as it appears. For Example: The Sun, or Moon, appear no bigger, at moſt, than a Cart-wheel, and of a flat Figure. The Earth ſeems to be plain: The Heavens to cover it like a Canopy, and to be contiguous to it round about: A Fire-brand nimbly moved round, appears like a Circle of Fire; and to give a parallel Inſtance, a Boat lying ſtill at Anchor in a River, to him that Sails and Rows by it, ſeems to move apace; and when the Clouds paſs nimbly under the Moon, the Moon itſelf ſeems to move the contrary way. And there have been whole Books written in Confutation of vulgar Errors. *Secondly*, As to the *Scripture*, when ſpeaking of theſe Things, it accommodates itſelf to the common and received Opinions, and employs the uſual Phraſes and Forms of Speech (as all wiſe Men alſo do, though, in Strictneſs, they be of a different or contrary Opinion) without Intention of delivering any thing Doctrinally concerning theſe Points, or confuting the contrary: And yet by thoſe that maintain the Opinion of the Earth's Motion, there might a convenient Interpretation be given of ſuch Places as ſeem to contradict it. Howbeit, becauſe ſome pious Perſons may be offended at ſuch an Opinion, as ſavouring of Novelty, thinking it inconſiſtent with Divine Revelation, I ſhall not poſitively aſſert it, only propoſe it as an *Hypotheſis* not altogether improbable. Suppoſing then, that the Earth doth move, both upon its own Poles, and in the Ecliptick about the Sun, I ſhall ſhew how admirably its Situation and Motion are contrived for the Conveniency of Man, and other Animals: Which I cannot do more fully and clearly than Dr. *More* hath already done in his *Antidote againſt Atheiſm*, whoſe Words therefore I ſhall borrow.

Firſt, Speaking of the *Paralleliſm* of the *Axis* of the *Earth*, he ſaith, I demand whether it be better to have the *Axis* of the Earth ſteady and perpetually parallel to itſelf, or to have it careleſly tumble this way and that way as it happens, or at leaſt very variouſly and intricately? And you cannot but anſwer me, it is better to have it ſteady and parallel; for in this lies the neceſſary Foundation of the Art of Navigation and Dialling. For that ſteady Stream of Particles, which is ſuppoſed to keep the *Axis* of the *Earth* parallel to itſelf, affords the Mariner both his *Cynoſura*, and his *Compaſs*. The *Load-ſtone* and the *Load-ſtar* depend both upon this. The *Load-ſtone*, as I could demonſtrate, were it not too great a Digreſſion; and the *Load-ſtar*, becauſe that which keeps the *Axis* parallel to itſelf, makes each of the *Poles* conſtantly reſpect ſuch a Point in the Heavens; as for Example, the *North-pole* to point almoſt directly to that which we call the *Pole-ſtar*. And beſides, *Dialling* could not be at all without this Steadineſs of the *Axis*. But both theſe Arts are pleaſant, and one eſpecially of mighty Importance to Mankind. For thus there is an orderly Meaſuring of our Time for Affairs at home, and an Opportunity of Traffick abroad with the moſt remote Nations of the World; and ſo there is a mutual Supply of the ſeveral Commodities of all Countries, beſides the enlarging our Underſtandings by ſo ample Experience we get both of Men and Things. Wherefore if we were rationally to conſult, whether the *Axis* of the *Earth* were better be held ſteady and parallel to itſelf, or left at random, we would conclude it ought to be ſteady, and ſo we find it *de Facto*, though the Earth move floating in the Liquid *Heavens*. So that appealing to our own Faculties we are to affirm, That the conſtant Direction of the *Axis* of the *Earth* was eſtabliſhed by a Principle of Wiſdom and Council.

Again, There being ſeveral Poſtures of this ſteady Direction of the *Axis* of the *Earth*, *viz.* either perpendicular to a Plane, going through the Center of the *Sun*, or Co-incident, or Inclining, I demand which of all theſe Reaſon and Knowledge would make choice of? Not of a perpendicular Poſture; for ſo both the pleaſant Variety, and great Convenience of

Summer and Winter, Spring and Autumn, would be loſt, and for want of Acceſſion of the Sun, theſe Parts of the Earth, which now bring forth Fruits, and are Habitable, would be in an Incapacity of ever bringing forth any; ſith then, the Heat could never be greater than now it is at our 10th of *March*, or the 11th of *September*, and therefore not ſufficient to bring their Fruits and Grain to Maturity, and conſequently could entertain no Inhabitants, and thoſe Parts that the full Heat of the Sun could reach, he plying them always alike without any annual Receſſion, or Intermiſſion, would at laſt grow tired, or exhauſted, or be wholly dried up, and want Moiſture, the Sun diſſipating and caſting off the Clouds Northwards and Southwards. Beſides, we obſerve that an orderly Viciſſitude of Things, doth much more gratifie the Contemplative Property in Man.

And now in the ſecond Place neither would Reaſon make choice of a co-incident Poſition. For if the *Axis* thus lay in a Plane that goeth through the Center of the *Sun*, the *Ecliptick* would like a *Colure*, or one of the *Meridians*, paſs through the *Poles* of the Earth, which would put the Inhabitants of the World into a pitiful Condition. For they that eſcape beſt in the *Temperate Zone*, would be accloyed with long Nights very tedious, no leſs than forty Days, and thoſe that now never have their Night above twenty-four Hours, as *Frieſland*, *Iſland*,

Iſland, the furtheſt Parts of *Ruſſia* and *Norway*, would be deprived of the Sun, above a Hundred and Thirty Days together. Ourſelves in *England*, and the reſt of the ſame Clime, would be cloſed up in Darkneſs no leſs than a Hundred, or Eighty Days; and ſo proportionably of the reſt, both in and out of the *Temperate Zones*. And as for Summer and Winter, though thoſe Viciſſitudes would be, yet it could not but cauſe raging Diſeaſes, to have the Sun ſtay ſo long, deſcribing his little Circles ſo near the Poles, and lying ſo hot on the Inhabitants, that had been in ſo long Extremity of Darkneſs and Cold before.

It remains therefore, that the Poſture of the *Axis* of the Earth be inclining not perpendicular, not co-incident to the fore-mention'd Plane. And verily, it is not only inclining, but in ſo fit a Proportion, that there can be no fitter imagined to make it, to the utmoſt Capacity, as well pleaſant as habitable. For though the Courſe of the Sun be curbed between the Tropicks, yet are not thoſe Parts directly ſubject to his perpendicular Beams, either Unhabitable, or extremely Hot, as the Ancients fanſied: By the Teſtimony of Travellers, and particularly Sir *Walter Rawleigh*, the Parts under and near the Line, being as fruitful and pleaſant, and fit to make a Paradiſe of, as any in the World. And that they are as ſuitable to the Nature of Man, and as convenient to live in, appears from the Longævity of the Natives; as for In-

Inſtance, the *Æthiopes*, called by the Ancients Μακρόβιοι; but eſpecially in the *Braſilians* in *America*, the ordinarly Term of whoſe Life is a Hundred Years, as is ſet down by *Piſo*, a Learned Phyſician of *Holland*, who travelled thither on purpoſe to augment Natural Knowledge, but eſpecially what related to Phyſick. And reaſonable it is that this ſhould be ſo; for neither doth the Sun lie long upon them, their Day being but Twelve Hours, and their Night as long, to cool and refreſh them: And beſides, they have frequent Showers, and conſtant Breezes, or freſh Gales of Wind from the *Eaſt*. It was the Opinion of *Aſclepiades*, as *Plutarch* reports, that generally the Inhabitants of Cold Countries are longer liv'd than thoſe of Hot, becauſe the Cold keeps in the Natural Heat, as it were locking up the Pores to prevent its Evaporation; whereas in Hot Regions the Heat is eaſily diſſipated, the Pores being large and open to give it way. Which Opinion, becauſe I find ſome Learned Men ſtill to adhere to, I ſhall produce ſome further Inſtances out of Monſieur *Rocheforts*'s Hiſtory of the *Antilles* Iſlands, to confirm the contrary, and to ſhew how often and eaſily we may be deceiv'd, if we truſt to our own Ratiocinations, how plauſible ſoever, and conſult not Experience.

“The ordinary Life (ſaith he) of our *Caribbeans* is an Hundred and Fifty Years long, and ſometimes more. There were ſome among them not long ſince living, who remembred to have ſeen the firſt *Spaniards* that aborded *America*, who, we may thence conclude, lived to be at leaſt 160 years old.

The *Hollanders* who traffick in the *Molucca* Iſlands, aſſure us, that the ordinary term of Life of the Natives there is one hundred and thirty years.

Vincent le Blanc tells us, that in *Sumatra*, *Java*, and the neighbouring Iſlands, the life of the Inhabitants is extended to 140 Years, and that in the Realm of *Caſſuby* it reaches 150. *Francis Pirara* promotes the life of the *Braſilians* beyond the Term we have ſet it, *v. g.* to 160 years or more, and ſays that in *Florida* and *Jucatan* there are Men found who paſs that Age. And it is ſaid, that the *French* in *Laudonier*'s Voyage into *Florida*, *Anno* 1564. ſaw a certain old Man, who affirmed himſelf to be three hundred years old, and the Father of five Generations; *And well he might be of double that number.*

Laſtly, *Mapheous* reports, that a certain *Bengaleſe* vaunted himſelf to be 335 years old. So far Monſieur *Rochefort*. Indeed theſe two laſt Inſtances, being perchance ſingular and extraordinary, do not prove the point; for even among us, where the ordinary term of Life is about threeſcore and ten, or fourſcore, there occur ſome rare inſtances of Perſons, who have lived 130, 140, 150 Years and more. But the other Teſtimonies being general, prove it beyond contradiction; neither yet is the thing in itſelf improbable; for there being not ſo great inequality of Weather in thoſe hot Countries, as there is in cold, the Body is kept in a more equal Temper, and not having ſuch frequent Shocks, as are occaſion'd by ſuch Air, and often changes, and that from one extreme to another, holds out much longer. So we ſee infirm and crazy Perſons, when they come to be ſo weak as to be fixed to their Beds, hold out many Years, ſome I have heard of, that have laid bed-rid 20 years: Becauſe in the Bed they are always kept in an almoſt equal Temper of Heat, who, had they been expoſed to the exceſſes of Heat and Cold, would not probably have ſurvived one.

Seeing then, this beſt poſture which our Reaſon could make choice of we ſee really eſtabliſhed in Nature, we cannot but acknowledge it to be the iſſue of Wiſdom, Counſel, and Providence. Moreover, a further Argument to evince this is, That though it cannot but be acknowledged, that if the *Axis* of the Earth were perpendicular to the Plane of the Ecliptick, her motion would be more eaſie and natural, yet notwithſtanding for the Conveniences fore-mentioned, we ſee it is made in an inclining poſture.

Another very conſiderable, and heretofore unobſerv'd Convenience of this inclination of the Earth's *Axis*, Mr, *Keill* affords us in *his Examination of* Dr. Burnet's *Theory of the Earth*, p. 69.

There is (ſaith he) one more [beſides what he had mentioned before] conſiderable advantage, which we reap by the preſent poſition of the Earth, which I will here inſert, becauſe I do not know that it is taken notice of by any. And it is, that by the preſent inclination of the Earth's *Axis* to the Plane of the *Ecliptick*, we who live beyond 45 degrees of Latitude, and ſtand moſt in need of it, have more of the Sun's heat throughout the year, than if he had ſhined always in the *Equator*, that is, if we take the ſum of the Sun's actions upon us both in Summer and Winter, they are greater than its Heat would be if he moved always in the *Equator*; or, which is the ſame thing, the aggregate of the Sun's heat upon us while he deſcribes any two oppoſite Parallels, is greater than it would be if in thoſe two Days he deſcribed the *Equator*. Whereas in the *Torrid Zone*, and even in the Temperate almoſt as far as 45 degrees of Latitude, the ſum of the Sun's heat in Summer and Winter is leſs than it would be, were the *Axis* of the Earth perpendicular to the Plane of the *Ecliptick*. For the Demonſtration of which, I refer the Reader to the Book itſelf.

I think (proceeds he) this Conſideration cannot but lead us into a tranſcendent admiration of the *Divine Wiſdom*, which hath placed the Earth in ſuch a poſture as brings with it ſeveral Conveniencies beyond what we can eaſily diſcover without Study and Application: And I make no queſtion, but if the reſt of the *Works of Nature* were well obſerved, we ſhould find ſeveral advantages which accrue to us by their preſent Conſtitution, which are far beyond the uſes of them that are yet diſcovered; by which it will plainly appear, that God hath choſen better for us than we could have done for ourſelves.

If any Man ſhould object and ſay, it would be more convenient for the Inhabitants of the Earth, if the Tropicks ſtood at a greater diſtance, and the Sun moved further Northward and Southward, for ſo the North and South Parts would be relieved, and not expoſed to ſo extreme Cold, and thereby rendred uninhabitable as now they are.

To this I anſwer, That this would be more inconvenient to the Inhabitants of the *Earth* in general, and yet would afford the *North* and *South* Parts but little more comfort; for then as much as the diſtances between the *Tropicks* were enlarg'd, ſo much would alſo the *Artick* and *Antartick* Circles be enlarg'd too; and ſo we here in *England*, and ſo on Northerly, ſhould not have that grateful and uſeful Succeſſion of Day and Night, but proportionably to the Sun's coming towards us, ſo would our Days be of more than Twenty-four hours length, and according to his receſs in Winter our Nights proportionable, which how great an inconvenience it would be, is eaſily ſeen. Whereas now the whole Latitude of the Earth, which hath at any time above Twenty-four Hours Day and Twenty-four ty-four Hours Night, is little and inconſiderable in compariſon of the whole Bulk, as lying near the *Poles.* And yet neither is that Part altogether unuſeful, for in the Waters there live Fiſhes, which otherwhere are not obvious; ſo we know the chief *Whale-fiſhing* is in *Greenland*: Yea, not only Fiſh, but great variety of Water-Fowl, both whole and cloven Footed, frequent the Waters, and feed there, breeding alſo on the Cliffs by the Sea-ſide, as they do with us: The Figures and Diſcriptions of a great many whereof are given us by *Martin* in his Voyage to *Spitzberg*, or *Greenland.* And on the Land, *Bears*, and *Foxes*, and *Deer*, in the moſt northerly Country that was ever yet touched, and doubtleſs, if we ſhall diſcover further to the very *North-Pole*, we ſhall find all that Tract not to be vain, uſeleſs, or unoccupied.

Thirdly, the third and laſt Thing I propoſed, was the Conſtitution and Conſiſtency of the Parts of the Earth. and firſt, Admirable it is, that the Waters ſhould be gathered together into ſuch great *Conceptacula*, and the dry Land appear; and though we had not been aſſured thereof by divine Revelation, we could not in Reaſon but have thought ſuch a Diviſion and Separation, to have been the Work of Omnipotency, and infinite Wiſdom and Goodneſs; for in this condition the Water nouriſhes and maintains innumerable Multitudes of various kinds of Fiſhes; and the dry Land ſupports and feeds as great variety of Plants and Animals, which have their firm Footing and Habitation: Whereas had all been *Earth*, all the Species of *Fiſhes* had been loſt, and all thoſe Commodities which the Water affords us; or all *Water*, there had been no living for Plants, or Terreſtrial Animals, or Man himſelf, and all the Beauty, Glory, and Variety of this Inferior World had been gone, nothing being to be ſeen, but one uniform dark Body of Water: Or had all been mixt and made up of Water and Earth into one Body of Mud or Mire, as one would think ſhould be moſt natural: For why ſuch a Separation, as at preſent we find, ſhould be made, no account can be given, but Providence. I ſay, had all this Globe been Mire, or Mud, then could there have been no poſſibility for any *Animals* at all to have lived, excepting ſome few, and thoſe very dull and inferior ones too. That therefore the *Earth* ſhould be made thus, and not only ſo, but with ſo great Variety of Parts, as Mountains, Plains, Vallies, Sand, Gravel, Lime, Stone, Clay, Marble, Argilla, *&c.* which are ſo delectable and pleaſant, and likewiſe ſo uſeful and convenient for the Breeding and Living of various Plants and Animals; ſome affecting Mountains, ſome Plains, ſome Valleys, ſome Watery Places, ſome Shade, ſome Sun, ſome Clay, ſome Sand, ſome Gravel, *&c.* That the Earth ſhould be ſo figured as to have Mountains in the Midland Parts; abounding with Springs of Water, pouring down Streams and

Rivers for the Neceſſities and Conveniencies of the Inhabitants of the lower Countries; and that the Levels and Plains ſhould be formed with ſo eaſie a declivity as to caſt off the Water, and yet not render Travelling or Tillage very difficult or laborious. Theſe things, I ſay, muſt needs be the reſult of Counſel, Wiſdom, and Deſign. Eſpecially when (as I ſaid before) not that way which ſeems more facile and obvious to Chance is choſen, but that which is more difficult and hard to be traced, when it is moſt convenient and proper for thoſe nobler Ends and Deſigns, which were intended by its Wiſe Creator and Governor. Add to all this, that the whole dry Land is, for the moſt part, covered over with a lovely Carpet of Green Graſs, and other Herbs, of a colour not only moſt grateful and agreable, but moſt uſeful and ſalutary to the Eye; and this alſo decked and adorned with great variety of Flowers of beautiful Colours and Figures, and of moſt pleaſant and fragrant Odours for the refreſhment of our Spirits, and our innocent Delight. As alſo with beautiful Shrubs, and ſtately Trees, affording us not only pleaſant and nouriſhing Fruits, many Liquors, Drugs, and good Medicines, but Timber, and Utenſils for all ſorts of Trades, and the Conveniencies of Man. Out of many Thouſands of which we will only juſt name a few, leſt we ſhould be tedious and too bulky.

Firſt, The *Coco*, or *Coker-Nut*-Tree, that ſupplies the *Indians* with almoſt whatever they ſtand in need of, as Bread, Water, Wine, Vinegar, Brandy, Milk, Oyl, Honey, Sugar, Needles, Thread, Linen, Clothes, Cups, Spoons, Beeſoms, Baskets, Paper, Maſts for Ships, Sails, Cordage, Nails, Coverings for their Houſes, *&c.* Which may be ſeen at large in the many printed Relations of Voyages and Travels to the *Eaſt-Indies*, but moſt faithfully in the *Hortus Malabaricus*, publiſhed by that immortal Patron of Natural Learning, *Henry Van Reede van Draakenſtein*, who has had great Commands and Employs in the *Dutch* Colonies.

Secondly, The *Aloe Muricata vel Aculeata*, which yields the *Americans* every thing their Neceſſities require, as Fences and Houſes, Darts, Weapons, and other Arms, Shoes. Linen, and Clothes, Needles and Thread, Wine and Honey, beſides many Utenſils, for all which *Hernandes*, *Garcililaſſo de la Vega*, and *Margrave*, may be conſulted.

Thirdly, The *Bandura Cingalenſium*, called by ſome the *Priapus Vegetabilis*, at the end of whoſe Leaves hang long Sacks or Bags, containing a pure limpid Water of great uſe to the *Natives*, when they want Rain for eight or ten Months together.

A parallel Inſtance to this of the *Bandura*, my Learned and Worthy Friend Dr. *Sloane* affords us in a Plant by him obſerved in the Iſland of *Jamaica*, and deſcribed by the Title of *Viſcum Caryophilloides Maximum flore tripetalo pallide luteo, ſemine filamentoſo*, which is commonly call'd, in that Iſland, *Wild Pine. Philoſoph. Tranſact. N°* 251. *Pag.* 114. I ſhall not tranſcribe the whole Deſcription, but only that Part of it which relates to this Particular: “From the Root (which he had deſcribed “before) ariſe Leaves on every ſide, after the “manner of Leeks, or *Anana's*, whence the “Name of *Wild-Pine*, or *Aloes*, being folded or “incloſed one within another, each of which “is two Foot and an half long, and from a “three Inch Breadth at Beginning, or Baſe, ends “in a Point, having a very hollow or concave “inward Side, and a round or convex outward “one: So that by all their hollow Sides is “made within a very large Preſervatory, Ciſ“tern or Baſin, fit to contain a pretty Quanti“ty of Water, which in the rainy Seaſon falls “upon the utmoſt Parts of the ſpreading “Leaves, which have Chanels in them, con“veying it down to the Ciſtern where it is “kept, as in a Bottle, the Leaves, after they “are ſwelled out like a bulbous Root to make “the Bottle, bending inward or coming again “cloſe to the Stalk, by that means hindring the “Evaporation of the Water, by the Heat of the “Sun-Beams.

“In the mountainous, as well as the dry “low Woods, in Scarcity of Water, this Re-

" ſervatory is not only neceſſary and ſufficient " for the Nouriſhment of the Plant itſelf, but " likewiſe is very uſeful to Men, Birds, and " all Sorts of Inſects, whether in Scarcity of " Water they come in Troops, and ſeldom go " away without Refreſhment.

" Captain *Dampier*, in his Voyages, *Vol.* II. " of *Campeche*, tells us, That theſe Baſins made " of the Leaves of the *Wild Pine*, will hold a " Pint and half or a Quart of Water, and that " when they find theſe *Pines*, they ſtick their " Knives into the Leaves juſt above the Roots, " and that lets out the Water, which they catch " in their Hats, as (ſaith he) I have done many " times, to my great Relief.

Fourthly, The *Cinnamon-Tree* of *Ceylon*, in whoſe Parts there is a wonderful Diverſity: Out of the Root they get a Sort of *Camphire*, and its Oyl; out of the Bark of the Trunk, the true Oyl of *Cinnamon*; from the Leaves, an Oyl like that of *Cloves*; out of the Fruit, a *Juniper* Oyl, with a Mixture of thoſe of *Cinnamon* and *Cloves*; beſides, they boil the Berries into a Sort of Wax, out of which they make Candles, Plaiſters, Unguents. Here we may take Notice of the *Candle-Trees* of the *Weſt-Indies*, out of whoſe Fruit, boil'd to a thick fat Conſiſtence, are made very good Candles, many of which have been lately diſtributed by that moſt ingenious Merchant, Mr. *Charles Dubois*.

Fifthly, The *Fountain*, or *Dropping-Trees*, in the Iſles of *Ferro*, *St. Thomas*, and in *Guiny*, which ſerve the Inhabitants inſtead of Rain, and freſh Springs: My honoured Friend, Dr. *Tancred Robinſon*, in a late Letter to me, is not of *Voſſius*'s Opinion, that theſe Trees are of the *Ferulaceous* Kind, becauſe he obſerves, that by the Deſcriptions of Eye-witneſſes, and by the dry'd Sample ſent by *Paludanus* to the Duke of *Wirtenberg*, the Leaves are quite different from thoſe of the *Ferula's*, coming nearer to the *Seſeli Ethiopicum Salicis vel Periclymeni folio*: Therefore the *Doctor* rather thinks them to be of the *Laurel*-kind, though he concludes here may be many different Sorts of theſe running Aqueous-Trees; becauſe that *Phænomenon* does not depend upon, or proceed from any Peculiarity of the Plant, but rather from the Place and Situation; of which he writes more at large, in a Letter printed in another Diſcourſe of mine.

Sixthly, and *Laſtly*, We will only mention the Names of ſome other Vegetables, which, with Eighteen or Twenty Thouſand more of that Kind, do manifeſt to Mankind the illuſtrious Bounty and Providence of the Almighty and Omniſcient Creator, towards his undeſerving Creatures; as the *Cotton-Trees*, the *Manyoc*, or *Caſſava*; the *Potatoe*; the *Jeſuit's-Bark-Tree*; the *Poppy*; the *Rhubarb*; the *Scam-*

mony; the *Jalap*; the *Coloquintida*; the *China*; *Sarſa*; the *Serpentaria Virginiana*, or *Snakeweed*; the *Niſi*, or *Genſeg*; the *Numeroſe Balſam*, and *Gum-trees*; many of which are of late much illuſtrated by the great Induſtry and Skill of that moſt diſcerning Botaniſt, Dr. *Leonard Plukenet*. Of what great Uſe all theſe, and innumerable other Plants, are to Mankind in the ſeveral Parts of Life, few or none can be ignorant; beſides the known Uſes in Curing Diſeaſes, in Feeding and Cloathing the Poor, in Building, in Dying: In all Mechanicks there may be as many more not yet diſcovered, and which may be reſerved on purpoſe to exerciſe the Faculties beſtowed on Man, to find out what is neceſſary, convenient, pleaſant, or profitable to him.

To ſum up all in brief: This *Terraqueous* Globe we know is made up of two Parts;

1. A thin and fluid.
2. A firm and conſiſtent.

The former, called by the Name of *Water*; the latter, of *Earth*, or *Dry Land*. The *Land*, being the more denſe and heavy Body, doth naturally deſcend beneath the Water, and occupy the lower Place; the *Water* aſcends and floats above it. But we ſee that it is not thus: For the *Land*, though the more heavy, is forcibly and contrary to its Nature ſo elevated as to caſt off the Water, and ſtand above it, being

ing (as the Pſalmiſt phraſes it) *Founded* upon, or *above the Seas, and eſtabliſhed above the Floods*, Pſal. 24. 2. And this in ſuch manner, that not only on one Side of the Globe, but on all ſides, there were probably Continents and Iſlands raiſed ſo equally as to counterballance one another, the Water flowing between them, and filling the hollow and depreſſed Places. Neither was the dry Land only raiſed up, and made to appear, but ſome Parts (which we call Mountains) were highly elevated above others; and thoſe ſo diſpoſed and ſituated (as we have ſhewn) in the mid-land Parts, and in continued Chains running *Eaſt* and *Weſt*, as to render all the Earth habitable, a great Part whereof otherwiſe would not have been ſo: But the *Torrid Zone* muſt indeed have been ſuch a Place as the Antients fanſied it, unhabitable for Heat. Let us now conſider how much better it is, that the dry Land ſhould be thus raiſed up, and the Globe divided almoſt equally between Earth and Water, than that all its Surface ſhould be one uniform and dark Body of Water. I ſay Water, becauſe that naturally occupies the ſuperior Place, and not Earth; for were it all Water, the whole Beauty of this inferior World were gone: There could be no ſuch pleaſant and delicious Proſpects as the Earth now affords us; no Diſtinction and grateful Variety of Mountains and Hills, Plains and Vallies, Rivers and Pools, and Fountains; no ſhady Woods ſtored with lofty and towring

Trees for Timber; lowly, and more ſpread ones, for Shade and Fruit: No amicable Verdure of Herbs, beſpangled with an infinite Variety of ſpecious and fragrant Flowers: For thoſe Plants that grow at the Bottom of the Sea, are for the moſt part of a dull, ſullen and dirty Olive Colour, and bear no Flowers at all. Inſtead of the elegant Shapes and Colours, the Sagacity and Docility of ingenious Beaſts and Birds, the muſical Voices and Accents of the Aereal Choriſters, there had been nothing but mute and ſtupid and indocile Fiſhes, which ſeem to want the very Senſe of Diſcipline, as may be gathered from that they are not Vocal, and that there appear in them no Organs of Hearing: It being alſo doubtful, whether the Element they live in be capable of tranſmitting Sounds, the beſt Senſe they have, even their Sight, can be but dull and imperfect; the Element of Water being Semiopake, and reflecting a good Part of the Beams of Light. The moſt noble and ingenious Creatures that live there, the Cetaceous Kind, being near a-kin to Terreſtrial Animals, and breathing in the ſame Element, the open Air. Had, I ſay, all been Water, there had been no Place for ſuch a Creature as Man; as we ſee there is no ſuch there: There is no Buſineſs for him, no Subject to employ his Art and Faculties, and conſequently there could be no Effects of them; no ſuch Things as Houſes and Cities, and ſtately Edifices, as Gardens and Orchards, and

Walks, and Labyrinths, as Corn-fields, and Vineyards, and the reſt of theſe Ornaments, wherewith the Wit and Induſtry of Man hath embelliſh'd the World.

Theſe are great Things, and worthy the Care and Providence of the Creator; which whoſo conſidereth, and doth not diſcern and acknowledge, muſt needs be as ſtupid as the Earth he goes upon.

But becauſe Mountains have been look'd upon by ſome as Warts, and ſuperfluous Excreſcencies, of no Uſe or Benefit; nay, rather as Signs and Proofs, that the preſent Earth is nothing elſe but a Heap of Rubbiſh and Ruins, I ſhall reduce and demonſtrate in Particulars, the great Uſe, Benefit, and Neceſſity, of them.

I. They are of eminent Uſe for the Production and Original of Springs and Rivers. Without Hills and Mountains there could be no ſuch Things, or at leaſt but very few: No more than we now find in plain and level Countries; that is, ſo few, that it was never my Hap to ſee one. In Winter-time indeed, we might have Torrents and Land-floods, and perhaps ſometimes great Inundations, but in Summer nothing but ſtagnating Water, reſerved in Pools and Ciſterns, or drawn up out of deep Wells. But as for a great Part of the Earth, (all lying within or near the Tropicks) it would neither have Rivers, nor any Rain at all: We ſhould conſequently loſe all thoſe Conveniencies, and Advantages that Rivers afford us, of Fiſhing, Navigation, Carriage, Driving of Mills, Engines, and many others. This End of Mountains I find aſſigned by Mr. *Edmund Hally*, a Man of great Sagacity and deep Inſight into the Natures and Cauſes of Things, in a Diſcourſe of his Publiſhed in the *Philoſoph. Tranſactions*, Numb. 192. in theſe Words: *This, if we may allow Final Cauſes,* [*Hardiment*, the Thing is clear, pronóunce boldly without any *Ifs* or *Ands*] *This ſeems to be one Deſign of the Hills, that their Ridges being placed through the midſt of their Continents, might ſerve as it were for Alembicks, to diſtil freſh Water for the Uſe of Man and Beaſt; and their Heights to give a Deſcent to thoſe Streams; to run gently, like ſo many Veins of the Microcoſm, to be the more beneficial to the Creation.*

II. They are of great Uſe for the Generation, and convenient Digging up of Metals and Minerals; which how neceſſary Inſtruments they are of Culture and Civility I have before ſhewn. Theſe we ſee are all digged out of Mountains, and I doubt whether there is, or can be any Generation of them, in perfectly plain and level Countries: But if there be, yet could not ſuch Mines, without great Pains and Charges, if at all, be wrought; the Delfs would be ſo flown with Waters (it being impoſſible to make any

Addits or *Soughs* to drain them) that no Gins or Machines could ſuffice to lay and keep them dry.

III. They are uſeful to Mankind in affording them convenient Places for Habitation and Situations of Houſes and Villages, ſerving as Skreens to keep off the cold and nipping Blaſts of the *Northern* and *Eaſterly* Winds, and reflecting the benign and cheriſhing Sun-beams, and ſo rendering their Habitations both more comfortable and more chearly in Winter; and promoting the Growth of Herbs and Fruit-trees, and the Maturation of their Fruits in Summer. Beſides caſting off the Waters, they lay the Gardens, Yards, and Avenues to the Houſes dry and clean; and ſo as well more Salutary, as more Elegant. Whereas Houſes built in Plains, unleſs ſhaded with Trees, lie bleak and expoſed to Wind and Weather, and all Winter are apt to be grievouſly annoyed with Mire and Dirt.

IV. They are very Ornamental to the Earth, affording pleaſant and delightful Proſpects, both, 1. To them that look downwards from them upon the ſubjacent Countries; as they muſt needs acknowledge, who have been but on the Downs of *Suſſex*, and enjoyed that raviſhing Proſpect of the Sea on one Hand, and the Country far and wide on the other. And, 2. To thoſe that look upwards and behold them from the Plains, and low Grounds; which what a Refreſhing and Pleaſure it is to the Eye, they are beſt able to judge who have lived in the Iſle of *Ely*, or other level Countries, extending on all Sides further than one can ken; or have been out far at Sea, where they can ſee nothing but Sky and Water. That the Mountains are pleaſant Objects to behold, appears, in that the very Images of them, their Draughts and Landskips, are ſo much eſteemed.

V. They ſerve for the Production of great Variety of Herbs and Trees; for it is a true Obſervation, That Mountains do eſpecially abound with different Species of Vegetables, becauſe of the great Diverſity of Soils that are found there, every *Vertex*, or Eminency, almoſt affording new Kinds. Now theſe Plants ſerve partly for the Food and Suſtenance of ſuch Animals as are proper to the Mountains, partly for Medicinal Uſes, the chief Phyſick-Herbs and Roots, and the beſt in their Kinds growing there: It being remarkable, That the greateſt and moſt luxuriant *Species* in moſt *Genera* of Plants are Native of the Mountains: Partly alſo for the Exerciſe and Diverſion of ſuch ingenious and induſtrious Perſons, as are delighted in ſearching out theſe natural Rarities; and obſerving the outward Form, Growth, Natures, and Uſes, of each *Species*, and reflecting upon the Creator of them his due Praiſes and Benedictions.

VI. They ſerve for the Harbour, Entertainment, and Maintenance of various Animals, Birds, Beaſts, and Inſects, that breed, feed, and frequent there; for the higheſt Tops and Pikes of the *Alps* themſelves, are not deſtitute of their Inhabitants, the *Ibex*, or *Stein-buck*, the *Rupicapra*, or *Chamois*, among Quadrupeds; the *Lagopus* among Birds; and I myſelf have obſerved beautiful *Papilio's*, and ſtore of other Inſects, upon the Tops of ſome of the *Alpine* Mountains. Nay, the higheſt Ridges of many of thoſe Mountains, ſerve for the Maintenance of Cattle for the Service of the Inhabitants of the Vallies: The Men there, leaving their Wives, and younger Children, below, do not, without ſome Difficulty, clamber up the Acclivities, dragging their Kine with them, where they feed them, and milk them, and make Butter and Cheeſe, and do all the Dairy-work, in ſuch ſorry Hovels and Sheds as they build there to inhabit in during the Summer Months: This I myſelf have ſeen and obſerved in Mount *Jura*, not far from *Geneva*, which is high enough to retain Snow all the Winter.

The ſame they do alſo in the *Griſons* Country, which is one of the higheſt Parts of the *Alps*; travelling through which I did not ſet Foot off Snow for four Days Journey, at the latter End of *March*.

VII. Thoſe long Ridges and Chains of lofty and topping Mountains, which run through the whole Continents *Eaſt* and *Weſt*, (as I have elſewhere obſerved) ſerve to ſtop the Evagation of the Vapours to the *North* and *South* in hot Countries, condenſing them like Alembick Heads into Water, and ſo by a kind of external Diſtillation giving Original to Springs and Rivers; and likewiſe by amaſſing, cooling, and conſtipating of them, turn them into Rain; by thoſe Means rendring the fervid Regions of the *Torrid Zone* habitable.

This Diſcourſe concerning the Uſe of Mountains, I have made uſe of in another * Treatiſe; but becauſe it is proper to this Place, I have, with ſome Alterations and Enlargements here repeated it.

* *The Diſſolution of the World.*

I had almoſt forgotten that Uſe they are of to Mankind, in ſerving for Boundaries and Defences to the Territories of Kingdoms and Commonwealths.

A ſecond Particular I have made choice of more exactly to ſurvey and conſider, is the Body of Man: Wherein I ſhall endeavour to diſcover ſomething of the Wiſdom and Goodneſs of God; Firſt, by making ſome general Obſervations concerning the Body. Secondly, by running over and diſcourſing upon its principal Parts and Members.

1. Then in general, I ſay, the Wiſdom and Goodneſs of God appears in the *erect Poſture* of the Body of Man, which is a Privilege and Advantage given to Man, above other Animals. But though this be ſo, yet I would not have you think, that all the Particulars I ſhall mention are proper only to the Body of Man, divers of them agreeing to many other Creatures. It is not my Buſineſs to conſider only the Prerogatives of Man above other Animals, but the Endowments and Perfections which Nature hath conferred on his Body, though common to them with him. Of this *Erection* of the *Body* of Man, the Antients have taken Notice as a particular Gift and Favour of God.

Pronàq; cùm ſpectent Animalia cætera terram,
Os homini ſublime dedit, cœlumq; tueri
Juſſit, & erectos ad Sydera tollere vultus.
Ovid. Metam. 1.

And before him, *Tully* in his ſecond Book, *De Nat. Deorum.*

Ad hanc providentiam naturæ tàm diligentem tàmq; ſolertem adjungi multa poſſunt, è quibus intelligatur quantæ res hominibus à Deo, quàmq; eximiæ tributæ ſunt, qui primùm eos humo excitatos, celſos & erectos conſtituit, ut Deorum cognitionem cœlum intuentes capere poſſent. Sunt enim è terra homines, non ut incolæ atq; habitatores,

tatores, ſed quaſi ſpectatores ſuperarum rerum atq; cœliſtium, quarum ſpectaculum ad nullum aliud genus animantium pertinet.

Man being the only Creator in this ſublunary World, made to contemplate Heaven, it was convenient that he ſhould have ſuch a Figure or *Situs* of the Parts of his Body, that he might conveniently look upwards. But to ſay the Truth in this reſpect of contemplating the Heavens, or looking upwards, I do not ſee what Advantage a Man hath by this Erection, above other Animals, the Faces of moſt of them being more ſupine than ours, which are only Perpendicular to the *Horizon*, whereas ſome of theirs ſtand reclining. But yet two or three other Advantages we have of this Erection, which I ſhall here mention.

Firſt, It is more Commodious for the ſuſtaining of the Head, which being full of Brains, and very heavy, (the Brain in Man being far larger in Proportion to the Bulk of his Body, than in any other Animal) would have been very painful and wearisome to carry, if the Neck had lain parallel or inclining to the Horizon.

Secondly. This Figure is moſt convenient for Proſpect, and looking about one. A Man may ſee further before him, which is no ſmall Advantage for avoiding Danger, and diſcovering whatever he ſearches after.

Thirdly, The Conveniency of this Site of our Bodies will more clearly appear, if we conſider what a pitiful Condition we had been in, if we had been conſtantly neceſſitated to ſtand and walk upon all Four; Man being by the Make of his Body, of all Quadrupeds, (for now I muſt compare him with them) the moſt unfit for that kind of *Inceſſus*, as I ſhall ſhew anon. And beſides that, we ſhould have wanted, at leaſt in a great Meaſure, the Uſe of our Hand, that unvaluable Inſtrument, without which he had wanted moſt of thoſe Advantages we enjoy as reaſonable Creatures; as I ſhall more particularly demonſtrate afterwards.

But it may be perchance objected by ſome, that Nature did not intend this Erection of the Body, but that it is ſuperinduced and artificial; for that Children at firſt creep on all Four, according to that of the Poet;

Mox Quadrupes, rituque tulit ſua membra ferarum. Ovid.

To which I anſwer, that there is ſo great an Inequality in the Length of our Legs and Arms, as would make it extreamly inconvenient, if not impoſſible, for us to walk upon all Four, and ſet us almoſt upon our Heads; and therefore we ſee that Children do not creep upon their Hands and Feet, but upon their

Hands and Knees; ſo that it is plain that Nature intended us to walk as we do, and not upon all Four.

2. I argue from the *Situs*, or Poſition of our Faces, for had we been to walk upon all Four, we had been the moſt prone of all Animals, our Faces being parallel to the Horizon, and looking directly downwards.

3. The Greatneſs and Strength of the Muſcles of the Thighs and Legs above thoſe of the Arms, is a clear Indication, that they were by Nature intended for a more difficult and laborious Action, even the moving and transferring the whole Body, and that Motion to be ſometimes continued for a great while together.

As for that Argument taken from the contrary Flexure of the Joints of our Arms and Legs to that of Quadrupeds, as that our Knees bend forward, whereas the ſame Joint of their Hind-legs bends backward; and that our Arms bend backward, whereas the Knees of their Fore-legs bend forward. Although the Obſervation be as old as *Ariſtotle*, becauſe I think there is a Miſtake in it, in not comparing the ſame Joints, (for the firſt or uppermoſt Joint in a Quadruped's Hind-legs bends forward, as well as a Man's Knees, which anſwer to it, being the uppermoſt Joint of our Legs; and the like *mutatis mutandis* may be ſaid of the Arms) I ſhall not inſiſt upon it.

Another Particular which may ſerve to demonſtrate, That this erect Poſture of the Body of Man was intended and deſigned by the Wiſe and Good Author of Nature, is the Faſtning of the Cone of the *Pericardium* to the Midriff; an Account whereof I ſhall give the Reader out of the ingenious Dr. *Tyſon*'s *Anatomy* of the *Orang-Outang*, or *Pigmie*, p. 49.

Veſalius (ſaith he) and others, make it a Peculiarity to Man, that the *Pericardium*, or Bag that incloſes the Heart, ſhould be faſtned to the *Diaphragm*. *Veſalius* tells us, (*De Corporis Humani fabrica*, lib. 6. cap. 8.) *Cæterùm involucri mucro, & dextri ipſius lateris egregia portio Septi tranſverſi nurveo circulo validiſſimè amploque admodum ſpatio connaſcitur, quod Hominibus eſt peculiare. The Point of the* Pericardium, *and a very conſiderable Portion of its right Side, is moſt firmly faſtned to the nervous Circle of the Midriff for a large Space, which is peculiar to Mankind.* So *Blancardius*, *Anat. Reformat.* cap. 2. p. 8. *Homo præ cæteris Animalibus hoc peculiare habet, quod ejus Pericardium Septi tranſverſi medio ſemper accreſcat, cùm idem in Quadrupedum genere liberum & aliquanto ſpatio ab ipſo remotum ſit: Man hath this peculiar to him, and different from other Animals, That his* Pericardium *doth always grow to the Middle of the Midriff; whereas in the Quadruped-kind it is free and removed ſome Diſtance from it.*

The *Pericardium* in Man is therefore thus faſtned, that in *Expiration* it might aſſiſt the

Diaſtole of the *Diaphragm:* For otherwiſe the Liver and Stomach being ſo weighty, they would draw it down too much towards the *Abdomen*, ſo that, upon the Relaxation of its Fibres in its *Diaſtole*, it would not aſcend ſufficiently into the *Thorax*, ſo as to cauſe a Subſidency of the Lungs by leſſening the Cavity there. In *Quadrupeds* there is no need of this Adheſion of the *Pericardium* to the *Diaphragm*; for in them, in *Expiration*, when the Fibres of the *Diaphragm* are relaxed, the Weight of the *Viſcera* of the *Abdomen* will eaſily preſs the *Diaphragm* up into the Cavity of the *Thorax*, and ſo perform that Service. Beſides, were the *Pericardium* faſtned to the *Diaphragm* in *Quadrupeds*, it would hinder its *Syſtole* in *Inſpiration*, or its Deſcent downwards upon the Contraction of its *Muſcular Fibres*; and the more, becauſe the *Diaphragm* being thus tied up, it could not then ſo freely force down the Weight of the *Viſcera*, which are always preſſing upon it, and conſequently not ſufficiently dilate the Cavity of the *Thorax*, and therefore muſt hinder their *Inſpiration*. Thus we ſee how neceſſary it is, that in *Man*, the *Pericardium* ſhould be faſtned to the *Diaphragm*, and in *Quadrupeds* how inconvenient it would be. *And ſince we find this Difference between the Hearts of Brutes and Men in this Particular, how can we imagine but that it muſt needs be the Effect of Wiſdom and Deſign, and that Man was intended by Nature to walk erect, and not upon all Four, as Quadrupeds do?*

II. The Body of Man may thence be proved to be the Effect of Wiſdom, becauſe there is nothing in it deficient, nothing ſuperfluous, nothing but hath its End and Uſe. So true are thoſe Maxims we have already made uſe of; *Natura nihil facit fruſtra*, and *Natura non abundat in ſuperfluis, nec deficit in neceſſariis*, no Part that we can well ſpare. *The Eye cannot ſay to the Hand, I have no need of thee, nor the Head to the Feet I have no need of you*; 1 Cor. xii. 21. that I may uſurp the Apoſtle's Similitude.

The Belly cannot quarrel with the Members, nor they with the Belly, for her ſeeming Sloth: As they provide for Meat for her, ſo ſhe concocts and diſtributes it to them. Only it may be doubted to what Uſe the *Paps* in Men ſhould ſerve. I anſwer, partly for Ornament, partly for a kind of Conformity between the Sexes, and partly to defend and cheriſh the Heart: In ſome they contain Milk, as in a *Daniſh* Family we read of in *Bartholine*'s *Anatomical Obſervations*. However, it follows not that they, or any other Parts of the Body, are uſeleſs, becauſe we are ignorant.

I have lately met with a Story in Seignior *Paulo Boccone*'s *Natural Obſervations*, printed at *Bologna* in *Italy*, 1684. well atteſted, concerning a Country-man, called *Billardino di Billo*, living in a Village belonging to the City of *Nocera* in *Umbria*, called *Somareggio*, whoſe Wife dying, and leaving a young Infant, he nouriſhed it with his own Milk. This

Man, either becauſe in the ſmall Village where he lived there was not a wet Nurſe to be had, or becauſe he was not able to hire one, took the Child, and applying it to his own Boſom, and putting the Nipples of his Breaſts into its Mouth, invited it to ſuck, which the Infant did, and after divers times drawing, fetch'd ſome Milk; whereat the Father encouraged, continued to apply it, and ſo after a while it brought down the Milk ſo plentifully as to nouriſh it for many Months, till it was fit to be weaned. Hereupon my Author having proved by ſufficient Authority of able Anotomiſts, ſuch as *Franciſcus Maria Florentinus*, and *Marcellus Malpighius*, that the Paps of Men have the ſame Structure, and the ſame Veſſels, with thoſe of Women, concludes, That Nature hath not given Paps to Men, either to no Purpoſe, or for meer Ornament; but, if Need requires, to ſupply the Defect of the Female, and give Suck to the Young.

Had we been born with a large Wen upon our Faces, or a *Bavarian* Poke under our Chins, or a great Bunch upon our Backs like *Camels*, or any the like ſuperfluous Excreſcency, which ſhould be not only uſeleſs but troubleſome, not only ſtand us in no ſtead, but alſo be ill-favoured to behold, and burdenſome to carry about, then we might have had ſome Pretence to doubt whether an intelligent and bountiful Creator had been our Architect; for had the Body been made by Chance, it muſt in all

Likelihood have had many of theſe ſuperfluous and unneceſſary Parts.

But now ſeeing there is none of our Members but hath its Place and Uſe, none that we could ſpare, or conveniently live without, were it but thoſe we account Excrements, the Hair of our Heads, or the Nails on our Fingers Ends; we muſt needs be mad or ſottiſh, if we can conceive any other than that an infinitely Good and Wiſe God was our Author and Former.

III. We may fetch an Argument of the Wiſdom and Providence of God from the convenient Situation and Diſpoſition of the Parts and Members of our Bodies: They are ſeated moſt conveniently for Uſe, for Ornament, and for mutual Aſſiſtance.

Firſt, For Uſe. So we ſee the Senſes of ſuch eminent Uſe for our Well-being, ſituate in the Head, as Sentinels in a Watch-Tower, to receive and convey to the Soul the Impreſſions of External Objects. *Senſus autem interpretes ac nuntii rerum in capite tanquam in arce mirificè ad uſus neceſſarios & facti & collocati ſunt.* Cic. de Nat. Deorum. The Eye can more eaſily ſee Things at a Diſtance, the Ear receives Sounds from afar; How could the Eye have been better placed, either for Beauty and Ornament, or for the Guidance and Direction of the whole Body? As *Cicero* proceeds well, *Nam Oculi tanquam ſpeculatores altiſſimum locum obtinent, ex quo plurima conſpicientes funguntur ſuo munere: Et*

Aures quæ ſonum recipere debent, qui naturâ in ſublime fertur, rectè in altis corporum partibus collocatæ ſunt; itemque Nares, eò quòd omnis odor ad ſuperiora fertur, rectè ſurſum ſunt. For the Eyes, like Sentinels, occupy the Higheſt Place, from whence ſeeing many Things, they perform their Functions; and the Ears, which are made for the Reception of Sounds, which naturally are carried upwards, are rightly placed in the uppermoſt Parts of the Body; alſo the Noſtrils, becauſe all Odors aſcend, are fitly ſituate in the ſuperior Parts. I might inſtance in the other Members: How could the Hands have been more conveniently placed for all Sorts of Exerciſes and Works, and for the Guard and Security of the Head and principal Parts? The Heart, to diſpenſe Life and Heat to the whole Body, *viz.* near the Center; and yet becauſe it is harder for the Blood to aſcend than deſcend, ſomewhat nearer the Head. It is alſo obſervable, That the Sinks of the Body are removed as far from the Noſe and Eyes as may be, which *Cicero* takes Notice of in the forementioned Place. *Ut in Ædificiis Architecti avertunt ab Oculis & Naribus Dominorum ea quæ profluentia neceſſariò eſſent tetri aliquid habitura, ſic natura res ſimiles procul amandavit à ſenſibus.*

Secondly, For Ornament. What could have been better contrived, than that thoſe Members which are Pairs, ſhould ſtand by one another in equal Altitude, and anſwer on each Side one to another? And, *Thirdly*, For mutual Aſſiſtance. We have before ſhewed how the Eye ſtands moſt conveniently for guiding the Hand, and the Hand for defending the Eye; and the like might be ſaid of the other Parts, they are ſo ſituate as to afford Direction and Help one to another. This will appear more clearly, if we imagine any of the Members ſituate in contrary Places or Poſitions. Had a Man's Arms been fitted only to bend backwards behind him, or his Legs only to move backwards, what Direction could his Eyes then have afforded him in Working or Walking? Or how could he then have fed himſelf? Nay, had one Arm been made to bend forward, and the other directly backward, we had then loſt half the Uſe of them, ſince they could not have aſſiſted one the other in any Action. Take the Eyes, or any other of the Organs of Senſe, and ſee if you can find any ſo convenient a Seat for them in the whole Body, as that they now poſſeſs.

IV. From the ample Proviſion that is made for the Defence and Security of the principal Parts: Thoſe are, 1. The *Heart*, which is the Fountain of Life and Vegetation, *Officina Spirituum vitalium*, *Principium & Fons Caloris nativi*, *Lucerna humidi radicalis*; and that I may ſpeak with the Chymiſts, *Ipſe Sol Microcoſmi*, *the very Sun of the Microcoſm*, or little World, in which is contained that vital Flame or heavenly Fire, which *Prometheus* is fabled to have ſtole from *Jupiter*; or, as *Ariſtotle* phraſes it, that ’Αιάλογον τῷ τῶν ἀπλανῶν ϛοιχείῳ. *Divinum quid reſpondens Elemento Stellarum.* This for more Security is ſituate in the Center of the Trunk of the Body, covered firſt with its own Membrane, called *Pericardium*, lodged within the ſoft Bed of the Lungs, encompaſs'd round with a double Fence, (1.) Of firm Bones or Ribs to bear off Blows; (2.) Of thick Muſcles and Skins, beſides the Arms, conveniently placed to fence off any Violence at a Diſtance, before it can approach to hurt it. 2. The *Brain*, which is the Principal of all Senſe and Motion, the Fountain of the Animal Spirits, the chief Seat and Palace Royal of the Soul; upon whoſe Security depends whatever Privilege belongs to us as Senſitive or Rational Creatures. This, I ſay, being the prime and immediate Organ of the Soul, from the right Conſtitution whereof proceeds the Quickneſs of Apprehenſion, Acuteneſs of Wit, Solidity of Judgment, Method and Order of Invention, Strength and Power of Memory; which if once weaken'd and diſorder'd, there follows nothing but Confuſion and Diſturbance in our Apprehenſions, Thoughts and Judgments, is environ'd round about with ſuch a Potent Defence, that it muſt be a mighty Force indeed that is able to injure it.

1. A Skull ſo hard, thick, and tough, that it is almoſt as eaſy to ſplit a Helmet of Iron as to make a Fracture in it. 2. This is covered with Skin and Hair, which ſerve to keep it warm, being naturally a very cold Part, and

alſo to quench and diſſipate the Force of any Stroke that ſhall be dealt it, and retund the Edge of any Weapon. 3. And yet more than all this, there is ſtill a thick and tough Membrane, which hangs looſer about it, and doth not ſo cloſely embrace it, (that they call *Dura Mater*;) and in caſe the Skull happens to be broken, doth often preſerve it from Injury and Diminution. And, laſtly, a thin and fine Membrane, ſtrait, and cloſely adhering, to keep it from quaſhing and ſhaking. The many Pairs of Nerves proceeding from it, and afterwards diſtributing and branching themſelves to all the Parts of the Body, either for Nutrition or Motion, are wonderful to behold in prepared Bodies, and even in the Schemes and Figures of Dr. *Willis* and *Vieuſſens*.

I might inſtance (3.) in the *Lungs*, which are ſo uſeful to us, as to Life and Senſe, that the Vulgar think our Breath is our very Life, and that we breathe out our Souls from thence: Suitable to which Notion, both *Anima* and *Spiritus* in *Latin*, and πνεῦμα in *Greek*, are derived from Words that ſignify Breath and Wind; and *efflare* or *exhalare Animam* ſignify to die. And the old *Romans* uſed to apply Mouth to Mouth, and receive the laſt Gaſps of their dying Friends, as if their Souls had come out that way. From hence, perhaps, might firſt ſpring that Opinion of the Vehicles of Spirits; the Vulgar, as I hinted before, conceiving that the Breath was, if not the Soul itſelf, yet that wherein it was wafted and carried away. Theſe

Lungs, I ſay, are, for their better Security and Defence, ſhut up in the ſame Cavity with the Heart.

V. In the abundant Proviſion that is made againſt evil Accidents and Inconveniences. And the Liberality of Nature, as to this Particular, appears, 1. In that ſhe hath given many Members, which are of eminent Uſe, by Pairs, as two Eyes, two Ears, two Noſtrils, two Hands, two Feet, two Breaſts, [*Mammæ*] two Reins; that ſo, if by any croſs or unhappy Accident one ſhould be diſabled or rendred uſeleſs, the other might ſerve us tolerably well; whereas had a Man but one Hand, or one Eye, *&c.* if that were gone, all were gone, and we left in an evil Caſe. See then, and acknowledge the Benignity of the Deity, who hath beſtowed upon us two Hands, and two Eyes, and other the like Parts, not only for our Neceſſity but Conveniency, ſo long as we enjoy them; and for our Security, in caſe any Miſchance deprive us of one of them. 2. In that all the Veſſels of the Body have many Ramifications; which particular Branches, though they ſerve mainly for one Member or Muſcle, yet ſend forth ſome Twigs to the neighbouring Muſcles; and ſo interchangeably the Branches that ſerve theſe ſend to them: So that if one Branch chance to be cut off or obſtructed, its Defect may, in ſome meaſure, be ſupplied by the Twigs that come from the neighbouring Veſſels. 3. In that ſhe hath provided ſo many ways to evacuate what might be hurtful to us, or breed Diſeaſes in our Bodies. If any thing oppreſs the Head, it hath a Power to free itſelf by Sneezing: If any thing fall into the Lungs, or if any Humour be diſchar'd upon them, they have a Faculty of clearing themſelves, and caſting it up by Coughing: If any thing clog or burden the Stomach, it hath an Ability of contracting itſelf, and throwing it up by Vomit. Beſides theſe ways of Evacuation, there are, Siege, Urine, Sweating, *Hæmorrhaiges* from the Noſe, and *hæmorrhoidal* Veins, Fluxes of Rheum. Now the Reaſon why Nature hath provided ſo many ways of Evacuation, is, becauſe of the different Humours that are to be voided or caſt out. When therefore there is a Secretion made of any noxious Humour, it is carried off by that Emunctory, whoſe Pores are fitted to receive and tranſmit the minute Parts of it: If at leaſt this Separation be made by Percolation, as we will now ſuppoſe, but not aſſert, yet I doubt not but the ſame Humour may be caſt off by divers Emunctories, as is clear in Urine and Sweat, which are for the main the ſame Humour carried off ſeveral ways.

To this Head of Proviſion againſt Inconveniences, I ſhall add an Obſervation or two concerning Sleep.

1. Sleep being neceſſary to Man and other Animals for their Refreſhment, and for the Reparation of that great Expence of Spirits, which

is made in the day-time, by the conſtant Exerciſe of the Senſes and Motions of the Muſcles, that it might eaſe and refreſh us indeed, Nature hath provided, that tho' we lie long upon one ſide, we ſhould have no Senſe of Pain or Uneaſineſs during our Reſt, no, nor when we awake. Whereas in Reaſon one would think, that the whole Weight of the Body preſſing the Muſcles and Bones on which we lie, ſhould be very burdenſome and uneaſy, and create a grievous Senſe of Pain; and we find by Experience that it doth ſo, when we lie long awake in the Night, we being not able (eſpecially if never ſo little indiſpoſed) to reſt one quarter of an Hour in the ſame Poſture without ſhifting of Sides, or at leaſt etching this way and that way, more or leſs. How this may be effected is a great Queſtion. To me it ſeems moſt probable, that it is done by an Inflation of the Muſcles, whereby they become both ſoft, and yet renitent like ſo many Pillows, diſſipating the Force of the Preſſure, and ſo preventing or taking away the Senſe of Pain. That the Muſcles are in this manner inflated in time of Reſt, appears to the very Eye in the Faces of Children, and may be proved from that when we reſt in our Clothes, we are fain to looſen our Garters, Shoe-Strings, and other Ligatures, to give the Spirits free Paſſage, elſe we ſhall experience Pain and Uneaſineſs in thoſe Parts, which when we are waking we find not.

The Reaſon of this *Phænomenon*, *viz.* that ἀναλγησία, or want of Pain, we experience in Sleep, during and after a long *decubitus* on one Side, Dr. *Liſter* in his *Journey to* Paris, *p.* 113. and Dr. *Jones* in his Treatiſe of the *Myſteries of* Opium *revealed*, attribute to the Relaxation of the Nerves and Muſcles in time of Sleep; and the Senſe of Pain and Uneaſineſs when we lie awake to the Tention of them during that time. This I do not deny, but yet I think the Reaſon I have aſſigned hath a great Intereſt in that Reſt and Eaſineſs we enjoy when a ſleep.

2. Becauſe Sleep is inconſiſtent with the Senſe of Pain, therefore during Reſt, thoſe Nerves which convey that Motion to the Brain, which excites in the Soul a Senſe of Pain, are obſtructed. This I myſelf have had frequent Experience of, ſince I have been troubled with Sores on my Legs. Upon ſudden awaking, finding myſelf at perfect Eaſe, and void of all Senſe of Pain for a Minute's time or more, the Pain then by degrees returning, which I could attribute to nothing but the diſſipating that Vapour, or whatever elſe it were, which obſtructed the Nerves, and giving the dolorifick Motion free Paſſage again.

Upon ſecond Thoughts, and reading what Dr. *Liſter* and Dr. *Jones* have written concerning this Subject, I rather incline to believe, that the Motion cuaſing a Senſe of Pain, is convey'd to the Brain by the Nerves themſelves in Tenſion,

ſion, as we ſee in Cords, any the leaſt Touch at one End paſſes ſpeedily to the other when they are ſtretch'd, which it doth not when they are relaxed, and not by the Spirits paſſing through them: And on the other ſide, the Unſenſibleneſs of Pain proceeds rather from the Relaxation of the Nerves than their Obſtruction. But yet this Tenſion of the Nerves and Muſcles is owing to the Spirits flowing down into them, and diſtending them.

VI. From the Conſtancy that is obſerved in the Number, Figure, Place, and Make of all the principal Parts; and from the Variety in the leſs. Man is always mending and altering his Works; but Nature obſerves the ſame Tenor, becauſe her Works are ſo perfect, that there is no Place for Amendments; nothing that can be reprehended. The moſt ſagacious Men in ſo many Ages, have not been able to find any Flaw in theſe Divinely contrived and formed Machines, *no Blot or Error in this great Volume of the World, as if any thing had been an imperfect Eſſay at the firſt*, (to uſe the Biſhop of *Cheſter*'s Words:) Nothing that can be altered for the better; nothing but if it were altered would be marred. This could not have been, had Man's Body been the Work of Chance, and not Council and Providence. Why ſhould there be conſtantly the ſame Parts; Why ſhould they retain conſtantly the ſame Places? Why ſhould they be endued with the ſame Shape and Figure? Nothing ſo contrary as Conſtancy and Chance. Should I ſee a Man throw the ſame Number a thouſand times together upon but three Dice, could you perſuade me that this were Accidental, and that there was no neceſſary Cauſe of it? How much more incredible then is it, that Conſtancy in ſuch a Variety, ſuch a Multiplicity of Parts, ſhould be the Reſult of Chance? Neither yet can theſe Works be the Effects of Neceſſity or Fate, for then there would be the ſame Conſtancy obſerved in the ſmaller as well as the larger Parts and Veſſels; whereas there we ſee Nature doth *ludere*, as it were, ſport itſelf; the minute Ramifications of all the Veſſels, Veins, Arteries, and Nerves, infinitely varying in Individuals of the ſame Species, ſo that they are not in any two alike.

VII. The great Wiſdom of the Divine Creator appears, in that there is Pleaſure annexed to thoſe Actions that are neceſſary for the Support and Preſervation of the *Individuum*, and the Continuation and Propagation of the *Species*; and not only ſo, but Pain to the Neglect or Forbearance of them. For the Support of the Perſon, it hath annex'd Pleaſure to Eating and Drinking; which elſe, out of Lazineſs or Multiplicity of Buſineſs, a Man would be apt to neglect, or ſometimes forget. Indeed, to be obliged to chew and ſwallow Meat daily for two Hours ſpace, and to find no Reliſh or Pleaſure in it, would be one of the moſt burdenſome and ungrateful Tasks of a Man's whole

Life. But becauſe this Action is abſolutely neceſſary, for abundant Security Nature hath inſerted in us a Painful Senſe of Hunger to put us in mind of it, and to reward our Performance, hath adjoined Pleaſure to it. And as for the Continuation of Kind, I need not tell you, that the Enjoyments which attend thoſe Actions are the higheſt Gratifications of Senſe.

VIII. The wonderful Art and Providence of the Contriver and Former of our Bodies, appears in the Multitude of Intentions he muſt have in the Formation of the ſeveral Parts, or the Qualifications they require, to fit them for their ſeveral Uſes. * *Galen* in his Book *De Formatione Fœtus*, takes notice, "That there are in a humane Body above Six hundred ſeveral Muſcles, and there are at leaſt Ten ſeveral Intentions or due Qualifications to be obſerved in each of theſe; proper Figure, juſt Magnitude, right Diſpoſition of its ſeveral Ends upper and lower, Poſition of the whole, the Inſertion of its proper Nerves, Veins, and Arteries, which are each of them to be duly placed, ſo that about the Muſcles alone, no leſs than Six thouſand ſeveral Ends or Aims are to be attended to. The Bones are reckoned to be 284. The diſtinct Scopes or Intentions in each of theſe are above 40, in all about 100000. And thus it is in ſome Proportion with all the other Parts, the *Skin, Ligaments, Veſſels, Glandules, Humors*:

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* *Biſhop of* Cheſter's Nat. Rel. *lib.* 1. *c.* 6.

" But more eſpecially with the ſeveral Mem-
" bers of the Body, which do, in regard of the
" great Variety and Multitude of thoſe ſeveral
" Intentions required to them, very much ex-
" ceed the *Homogeneous* Parts. And the Fail-
" ing in any one of theſe, would cauſe Irre-
" gularity in the Body, and in many of them
" ſuch as would be very notorious." Now to imagine that ſuch a Machine compoſed of ſo many Parts, to the right Form, Order, and Motion, whereof ſuch an infinite Number of Intentions are required, could be made without the Contrivance of ſome wiſe Agent, muſt needs be irrational in the higheſt Degree.

This wonderful Mechaniſm of Humane Bodies, next to viewing the Life, may be ſeen at large in the excellent Figures of *Spigelius* and *Bidloo*, their Situation, Order, Connexion, and Manner of ſeparating them, in *Lyſerus* his *Cult. Anatom.* The almoſt infinite Ramifications, and Inoſculations of all the ſeveral Sorts of Veſſels, the Structures of the Glands, and other Organs, may eaſily be detected by Glaſſes, and trac'd by blowing in of Air, and drying them, or by injecting through peculiar Syringes, melted Wax, or Quickſilver; the Operations whereof may be learnt out of *Swammerdam*, *Caſpar Bartholine*, and *Antonio Nuck*.

IX. Another Argument of Wiſdom and Deſign in Contrivance of the Body of Man, and other Animals, is the Fitting of ſome Parts to divers Offices and Uſes, whereby Nature doth (as the Proverb is) *Unâ fideliâ duos parietes dealbare*; *Stop two Gaps with one Buſh.* So, for Inſtance, the *Tongue* ſerves not only for Taſting, but alſo to aſſiſt the Maſtication of the Meat and Deglutition, by turning it about, and managing it in the Mouth, to gather up the Food in Man by licking; in the Dog and Cat-kind by laping; in Kine, by plucking up the Graſs: Particularly in Man, it is of admirable Uſe for the Formation of Words and Speaking.

The Diaphragm and Muſcles of the *Abdomen*, or Lower-Belly, are of Uſe, not only for Reſpiration, but alſo for compreſſing the Inteſtines, and forcing the Chyle into the Lacteal Veins, and likewiſe out of the ſaid Veins into the *Thoracick* Chanel: And here, to note that by the way, appears the Uſe of a common *Receptacle* of Chyle, that by the Motion of the Muſcles of Reſpiration, it being preſſed upon, the Chyle might with more Facility be impelled into the forementioned Duct. Beſides, this Action of Reſpiration and Motion of the ſaid Diaphragm and Muſcles, may ſerve alſo for the Comminution and Concoction of the Meat in the Stomach (as ſome, not without Reaſon, think) by their conſtant Agitation and Motion upwards and downwards, reſembling the Pounding or Braying of Materials in a Mortar.

And to inſtance in no more, the muſcular Contraction and Pulſe of the Heart ſerves not only for the Circulation of the Blood, but alſo for the more perfect Mixture of its Parts, preſerving its due Craſis and Fluidity, and incorporating the Chyle and other Juices it receives with it.

X. The Wiſdom and Goodneſs too of the Divine Former of our Bodies appears in the Nouriſhment of them: For that Food which is of a wholſome Juice, and proper to nouriſh and preſerve them in a healthful State, is both pleaſant to the Taſte, and grateful and agreable to the Stomach, and continues to be ſo till our Hunger and Thirſt be well appeaſed, and then begins to be leſs pleaſant, and at laſt even nauſeous and loathſome. *The full Stomach loaths the Honey-Comb.*

On the other ſide, that which is unwholſome and unfit for Nouriſhment, or deſtructive of Health, is alſo unpleaſant to the Taſte, and ungrateful and diſagreable to the Stomach, and that more, or leſs, according as it is more, or leſs, improper, or noxious. And though there be ſome Sorts of Food leſs pleaſant to the Taſte, which by Uſe may be rendred grateful; yet to Perſons that are in Health, and in no Neceſſity of uſing ſuch Viands, I think it were better to abſtain from them, and follow Nature in eating ſuch Things as are agreable to their Palate and Stomach: For ſuch unpleaſant Diet muſt needs alter the Temper of the Body, before it can become acceptable; and doubtleſs for the worſe.

I might add hereto, that even Pain, which is the moſt grievous and afflictive Thing that we are ſenſible of, is of great Uſe to us. God hath annexed a Senſe of Pain to all Diſeaſes and Harms of the Body inward and outward, (and there is no Pain but proceeds from ſome Harm, or Diſeaſe) to be an effectual Spur to excite and quicken us to ſeek for ſpeedy Help, or Remedy; and hath ſo order'd it, that as the Diſeaſe heals, ſo the Pain abates. Neither doth Pain provoke us only to ſeek Eaſe and Relief when we labour under it, but alſo makes us careful to avoid for the future all ſuch Things as are productive of it; that is, ſuch Things as are hurtful to our Bodies, and deſtructive of the Health and Well-being of them, which alſo are, for the moſt Part, prohibited by God, and ſo ſinful and injurious to our Souls. So we ſee what Care the Divine Providence hath taken, and what effectual Means it hath uſed for the Healing of our Diſeaſes, and the Maintenance and Preſervation of our Health. This is the true Reaſon of Pain: Howbeit, I will not deny, but that God doth ſometimes Himſelf immediately inflict Diſeaſes, even upon his own Children, for many good Conſiderations which I ſhall not here enumerate. Neither ſhall I mention the Uſes that Parents and Maſters make of it, for the correcting their Children and Servants, or Magiſtrates for the puniſhing of Malefactors, they being beyond my Scope; only I cannot but take Notice, that it is a *πολύχρηστον*, a Thing of manifold Uſes, and neceſſary for the Government both of Commonwealths and Families.

XI. Some fetch an Argument of Providence from the Variety of Lineaments in the Faces of Men, which is ſuch, that there are not two Faces in the World abſolutely alike; which is ſomewhat ſtrange, ſince all the Parts are *in Specie* the ſame. Were Nature a blind Architect, I ſee not but the Faces of ſome Men might be as like, as Eggs laid by the ſame Hen, or Bullets caſt in the ſame Mould, or Drops of Water out of the ſame Bucket. This Particular I find taken notice of by *Pliny* in his Seventh Book, *cap.* 1. in theſe Words; *Jam in facie vultuque noſtro, cum ſint decem aut paulò plura membra, nullas duas in tot millibus hominum indiſcretas effigies exiſtere, quod Ars nulla in paucis numero præſtet affectando*; to which, among other things, he thus prefaces, *Naturæ verò rerum vis atque majeſtas in omnibus momentis fide caret.*

Though this at firſt may ſeem to be a Matter of ſmall Moment, yet, if duly conſider'd, it will appear to be of mighty Importance in all Humane Affairs: For ſhould there be an undiſcernible Similitude between divers Men, what Confuſion and Diſturbance would neceſſarily follow? What Uncertainty in all Sales and Conveyances, in all Bargains and Contracts? What Frauds and Cheats, and Suborning of Witneſſes? What a Subverſion of all Trade and Commerce? What Hazard in all

Judicial Proceedings? In all Aſſaults and Batteries, in all Murders and Aſſaſſinations, in Thefts and Robberies, what Security would there be to Malefactors? Who could ſwear that ſuch and ſuch were the Perſons that committed the Facts, though they ſaw them never ſo clearly? Many other Inconveniencies might be inſtanced in: So that we ſee this is no contemptible Argument of the Wiſdom and Goodneſs of God.

Neither is the Difference of Voices leſs conſiderable for the diſtinguiſhing of Sexes and particular Perſons, and Individuals of all Animals, than that of Faces; as Dr. *Cockburn* makes out, *Eſſay*, &c. *Part* II. *Pag.* 68. &c. Nay, in ſome Caſes more; for hereby Perſons in the dark, and thoſe that are blind, may know and diſtinguiſh one another, which is of great Importance to them; for otherwiſe they might be moſt groſly cheated and abuſed.

Farther we may add out of the ſame Author, *p.* 71. "And to no other Cauſe [than "the Wiſe Providence of God] can be refer"red the no leſs ſtrange Diverſity of Hand"writings. Common Experience ſhews, that "though Hundreds and Thouſands were "taught by one Maſter, and one and the ſame "Form of Writing, yet they ſhould all write "differently: Whether Men write *Court* or "*Roman* Hand, or any other, there is ſome"thing peculiar in every one's Writing, which "diſtinguiſheth it. Some, indeed, can coun"terfeit another's Character and Subſcription;

" but the Inſtances are rare; nor is it done
" without Pains and Trouble: Nay, the moſt
" expert and ſkilful cannot write much ſo ex-
" actly like, as that it cannot be known, whe-
" ther it be Genuine, or Counterfeit. And if
" the Providence of God did not ſo order it,
" what Cheats and Forgeries too would daily
" be committed, which would not only juſtle
" private Men out of their Rights, but alſo
" unhinge States and Governments, and turn
" all into Confuſion? The Diverſity of Hand-
" writings is of mighty great Uſe to the Peace
" of the World; it prevents Fraud, and ſe-
" cures Mens Property; it obligeth the Living
" and Preſent to Honeſty and Faithfulneſs; it
" importeth the Mind of the Abſent, and
" ſheweth the Will of the Dead, which ought
" to be ſacredly obſerved. And what is ſo
" very Uſeful, is not the Effect of any hu-
" mane Concert. Men did not of themſelves
" agree to it, they are only carried to it by the
" ſecret Providence of God, who underſtan-
" deth and mindeth what is for the Good and
" Intereſt of Mankind in general, and of every
" particular Perſon.

Add farther to all this, That whereas there are ſeveral Parts peculiar to Brutes, which are wanting in Man; as for Example, the ſeventh, or ſuſpenſory Muſcle of the Eye, the nictating Membrane, the ſtrong *Aponeuroſes* on the Sides of the Neck, called by ſome *Packwax*, it is very remarkable, that theſe Parts are of eminent and conſtant Uſe to them, as I ſhall par-

ticularly

ticularly ſhew hereafter, but to Man would have been altogether uſeleſs and ſuperfluous.

I have done with my general Obſervations. I proceed now more accurately and minutely to conſider ſome particular Parts, or Members of the Body; and Firſt, The *Head*, becauſe it was to contain a large Brain made of the moſt capacious Figure, as near as could be to a Spherical; upon this grows the Hair, which, though it be eſteemed an Excrement, is of great Uſe (as I ſhewed before) to cheriſh and keep warm the Brain, and to quench the Force of any Stroke that might otherwiſe endanger the Skull. It ſerves alſo to disburden the Brain of a great deal of ſuperfluous Moiſture wherewith it abounds.

I find it remark'd by *Machetti*, a famous Anatomiſt in *Padua*, that the Cauſe of Baldneſs in Men is the Drineſs of the Brain, and its ſhrinking from the *Cranium*, or Skull; he having obſerv'd, that in bald Perſons, under the bald Part, there was always a Vacuity, or empty Space between the Skull and the Brain. And, Laſtly, to name no more, it ſerves alſo for a graceful Ornament to the Face, which our preſent Age is ſenſible enough of, beſtowing ſo much Money upon falſe Hair and Periwigs.

Secondly, Another Member which I ſhall more particularly treat of, is the *Eye*, a Part ſo artificially compoſed, and commodiouſly ſituate, as nothing can be contrived better for

Uſe, Ornament or Security, nothing to Advantage added thereto, or altered therein. Of the Beauty of the Eye I ſhall ſay little, leaving that to Poets and Orators: That it is a very pleaſant and lovely Object to behold, if we conſider the Figure, Colours and Splendor of it, is the leaſt that I can ſay. The Soul, as it is more immediately and ſtrongly moved and affected by this Part than any other, ſo doth it manifeſt all its Paſſions and Perturbations by this. As the Eyes are the Windows to let in the *Species* of all Exterior Objects into the dark Cells of the Brain, for the Information of the Soul; ſo are they flaming Torches to reveal to thoſe Abroad, how the Soul within is moved or affected. Theſe Repreſentations made by the Impreſſions of External Objects upon the Eye, are the moſt clear, lively and diſtinct of any others. Now to this Uſe and Purpoſe of informing us what is Abroad round about us in this aſpectable World, we ſhall find this Structure and Mechaniſm of the Eye, and every Part thereof, ſo well fitted and adapted, as not the leaſt Curioſity can be added; for, firſt of all, the Humours and Tunicles are purely tranſparent, to let in the Light and Colours unfoiled and unſophiſticated by any inward Tincture. It is uſually ſaid by the *Peripateticks*, that the Cryſtalline Humour of the Eye (which they eneptly fancied to be the immediate Organ of Viſion, wherein all the Species of External Objects were terminated) is without all Colour, becauſe its Office was to diſcern all Colours, or at leaſt, to receive the Species of ſeveral Colours, and convey them to the common Senſe. Now if itſelf had been coloured, it would have tranſmitted all viſible Objects tinctured with the ſame Colour; as we ſee whatever is beheld through a coloured Glaſs, appears of the ſame Colour with the Glaſs; and to thoſe that have the Jaundice, or the like Suffuſion of Eyes, Objects appear of that ſame Colour wherewith their Eyes are infected. This they ſay, is in a great Meaſure true, altho' they are much miſtaken about the Organ and Manner of Viſion, and the Uſes of the Humours and Membranes of the Eye. Two Reaſons therefore may be aſſigned, why all the Membranes and Humours of the Eye are perfectly pellucid, and void of Colour, *Firſt*, For the Clearneſs. *Secondly*, For the Diſtinctneſs of Viſion.

Firſt, The Clearneſs; for had the Tunicles and Humours of the Eye, all, or any of them, been colorate, many of the Rays proceeding from the viſible Object, would have been ſtopt and ſuffocated before they could come to the Bottom of the Eye, where the formal Organ of Viſion is ſituate; for it is a moſt certain Rule, how much any Body hath of Colour, ſo much hath it of Opacity, and by ſo much the more unfit it is to tranſmit the Species.

Secondly, For the Diſtinctneſs of Viſion; for, as I ſaid before, and the *Peripateticks* obſerve well, were the Humours of the Eye tinctured with any Colour, they would refund that Colour upon the Object, and ſo it would not be repreſented to the Soul, as in itſelf it is. So we ſee, that through a coloured Glaſs Things appear as well more dim and obſcure, as tinctured with the Colour thereof.

Secondly, The Parts of the Eye are made convex, and eſpecially the Cryſtalline Humour, which is of a lenticular Figure, convex on both Sides; that, by the Refractions there made, there might be a Direction of many Rays coming from one Point in the Object, *viz.* as many as the Pupil can receive, to one Point anſwerable in the Bottom of the Eye, without which the Senſe would be very obſcure, and alſo confuſed. There would be as much Difference in the Clearneſs and Diſtinction of Viſion, were the outward Surface of the *Tunica Cornea* plain, and the Cryſtalline Humour removed, as between the Picture received on white Paper in a dark Room through an open or empty Hole, and the ſame received through a Hole furniſhed with an exactly poliſh'd lenticular Cryſtal; which, how great it is, any one, that hath but ſeen this Experiment made, knows well enough. Indeed this Experiment doth very much explain the Manner of Viſion, the Hole anſwering to the Pupil of the Eye, the Cryſtalline Humour to the lenticular Glaſs, the dark Room to the Cavity, containing the vitreous Humour, and the white Paper to the *Tunica Retina.*

Thirdly, The Uveous Coat, or *Iris* of the Eye, hath a muſculous Power, and can dilate and contract that round Hole in it, called the Pupil, or Sight of the Eye. It contracts it for the excluding ſuperfluous Light, and preſerving the Eye from being injured by too vehement and lucid an Object, and again dilate it for the apprehending Objects more remote, or placed in a fainter Light; *tam miro artificio* (ſaith *Scheiner*) *quam munifica naturæ largitate.* If any one deſires to make Experiment of theſe Particulars, he may, following *Scheiner* and *Des Cartes* their Direction, take a Child, and ſetting a Candle before him, bid him look upon it, and he ſhall obſerve his Pupil contract itſelf very much, to exclude the Light, with the Brightneſs whereof it would otherwiſe be dazzled and offended; as we are, when after we have been ſome time in the dark, a bright Light is ſuddenly brought in and ſet before us, till the Pupils of our Eyes have gradually contracted themſelves: Let the Candle be withdrawn or removed aſide, he ſhall obſerve the Child's Pupil by Degrees to dilate itſelf. Or let him take a Bead, or the like Object, and holding it near the Eye, command the Child to look at it, the Pupil will contract much when the Object is near; but let it be withdrawn to a greater Diſtance in the ſame Light, and he ſhall obſerve the Pupil to be much enlarged.

Fourthly, The Uveous Coat, and alſo the Inſide of the *Choroides*, are blacken'd like the Walls of a Tennis-Court, that the Rays may be there ſuffocated and ſuppreſſed, and not reflected backwards to confound the Sight: And if any be, by the Retiform Coat, reflected, they are ſoon choaked in the black Inſide of the *Uvea*. Whereas were they reflected to and fro, there could be no diſtinct Viſion: As we ſee the Light admitted into the dark Room we even now ſpeak of, obliterates the *Species* which before were ſeen upon the white Cloath or Paper.

Fifthly, Becauſe the Rays from a nearer, and from a more remote Object, do not meet juſt in the ſame Diſtance behind the Cryſtalline Humour, (as may eaſily be obſerved in Lenticular Glaſs, where the Point or Concourſe of the Rays from a nearer Object is at a greater Diſtance behind the Glaſs, and from a farther at a leſſer) therefore the *Ciliary Proceſſes*, or rather the Ligaments, obſerved in the Inſide of the Sclerotick Tunicles of the Eye by a late ingenious Anatomiſt, do ſerve inſtead of a Muſcle, by their Contraction to alter the Figure of the Eye, and make it broader, and conſequently draw the *Retina* nearer to the Cryſtalline Humour; and by their Relaxation ſuffer it to return to its natural Diſtance, according to the Exigency of the Object, in reſpect of Diſtance or Propinquity: And beſides, poſſibly the Ciliary Proceſſes may, by their Conſtriction or Relaxation, render the Cryſtalline itſelf more gibboſe or plain; and with the Help of the Muſcles, a little alter the Figure of the whole Eye for the ſame Reaſon. To what I have ſaid, might be added, that the *re-*

tiform Tunicle is whitiſh, for the better and more true Reception, of the *Species* of Things: That there being a Diſtance neceſſarily required for the Collection of the Rays receiv'd by the Pupil, *viz.* thoſe that proceed from one Point of the Object to one Point again in the Bottom of the Eye, the *Retina* muſt needs be ſet at a Diſtance from the Cryſtalline Humour: And therefore, Nature hath provided a large Room, and filled it with the pellucid vitreous Humour moſt fit for that Purpoſe.

I muſt not omit a notable Obſervation concerning the Place of the Inſertion of the Optick Nerve into the Bulb of the Eye, and the Reaſon of it; which I owe to that learned Mathematician *Peter Herigon*; *Nervus Opticus* (ſaith he in his *Optica*) *ad latus ponitur, ne pars imaginis in ejus foramen incidens picturâ careat; The Optick Nerve is not ſituate directly behind the Eye, but on one ſide, leſt that Part of the Image that falls upon the Hole of the Optick Nerve, ſhould want its Picture.* This I do not conceive to be the true Reaſon of this Situation; for even now as it is ſituate, that Part of the Object, whoſe Rays fall upon the Center or Hole of the Optick Nerve, wants its Picture, as we find by Experience; that Part not being ſeen by us, though we heed it not: But the Reaſon is, becauſe if the Optick *Axis* ſhould fall upon this Center (as it would do, were the Nerve ſeated juſt behind the Eye) this great Inconvenience would follow, that the middle Point of every Object we viewed would be inviſible, or there would be a dark Spot appear in the midſt of it. Thus we ſee the admirable Wiſdom of Nature in thus placing the Optick Nerve in reſpect of the Eye; which he that did not conſider or underſtand, would be apt to think more inconveniently ſituate for Viſion, than if it had been right behind.

Another Thing alſo concerning Viſion is moſt remarkable, that though there be a Decuſſation of the Rays in the Pupil of the Eye, and ſo the Image of the Object in the *Retina*, or Bottom of the Eye, be inverted, yet doth not the Object appear inverted, but in its right or Natural Poſture: The Reaſon whereof is, becauſe the Viſual Rays coming in ſtreight Lines, by thoſe Points of the Senſory or *Retina* which they touch, affect the common Senſe or Soul, according to their Direction; That is, ſignify to it, that thoſe ſeveral Parts of the Object from whence they proceed, lie in ſtreight Lines, (Point for Point) drawn through the Pupil to the ſeveral Points of the Senſory where they terminate, and which they preſs upon. Whereupon the Soul muſt needs conceive the Object, not in an inverted, but a right Poſture; and that the Nerves are naturally made, not only to inform the Soul of External Objects which preſs upon them, but alſo of the Situation of ſuch Objects, is clear, becauſe if the Eyes be deſtorted, the Object, will we nill we, will appear double: So if the fore and middle Fingers be croſs'd, and a round Body put between them, and moved, it will ſeem to be two; the Reaſon is, becauſe in that Poſture of the Fingers the Body touches the Outſides of them, which in their natural Site are diſtant one from another, and their Nerves made to ſignify to the Soul Bodies ſeparate and diſtant in like manner, two Fingers lying between them. And tho' our Reaſon, by the Help of our Sight, corrects this Error, yet cannot we but fancy it to be ſo.

Neither is the *aqueous Humour*, as ſome may ſupinely imagine, altogether uſeleſs or unprofitable as to Viſion, becauſe by its Help the *Uvea Tunica* is ſuſtained, which elſe would fall flat upon the Cryſtalline Humour; and fluid it muſt be to give way to the Contraction and Dilatation of the Uveous: And becauſe the outermoſt Coat of the Eye might chance to be wounded or pricked, and this Humour being fluid, let out, therefore Nature hath made Proviſion ſpeedily to repair it again in ſuch a Caſe, by the help of certain Water-pipes, or Lymphæducts, inſerted into the Bulb of the Eye, proceeding from Glandules deſign'd by Nature to ſeparate this Water from the Blood for that Uſe. *Antonius Nuck* affirms, that if the Eye of an Animal be prick'd, and the aqueous Humour ſqueez'd out, in ten Hours Space the ſaid Humour and Sight ſhall be reſtored to the Eye, if at leaſt the Creature be kept in a dark Place. And that he did publickly demonſtrate the ſame in the Anatomical Theatre at *Leyden*, in a Dog, out of whoſe Eye being wounded the aqueous Humour did ſo copiouſly flow, that the Membranes appeared flacid, and yet in ſix Hours Space the Bulb of the Eye was again replete with its Humour, and that without the Application of any Medicines. *Antonius Nuck de Ductu novo ſalivali*, &c.

Moreover, it is remarkable, That the *Cornea Tunica* [horny or pellucid Coat of the Eye] doth not lie in the ſame *Superficies* with the White of the Eye, but riſeth up, as it were a Hillock, above its Convexity, and is of an *Hyperbolical* or *Parabolical* Figure: So that tho' the Eye ſeems to be perfectly round, in Reality it is not ſo, but the *Iris* thereof is protuberant above the White; and the Reaſon is, becauſe that if the *Cornea Tunica*, or Cryſtalline Humour, had been concentrical to the *Selerodes*, the Eye could not have admitted a whole Hemiſphere at one View, *& ſic Animalis incolumitati in multis rebus minus cautum eſſet*, as *Scheiner* well obſerves. In many Things there had not been ſufficient Caution or Care taken for the Animal's Safety.

Dr. More's *Antidote againſt Atheiſm.*

And now (that I may uſe the Words of a late Author of our own) the Eye is already ſo perfect, that I believe the Reaſon of a Man would eaſily have reſted here, and admired at his own Contrivance. For he being able to move his whole Body upward and downward, and on every Side, might have unawares thought himſelf ſufficiently well provided for; but Nature hath added Muſcles alſo to the Eyes, that no

Perfection might be wanting: For we have often occaſion to move our Eyes, our Head being unmoved, as in reading and viewing more particularly an Object ſet before us, by transferring the *Axes* of our Eyes all over it: And that this may be done with the more Eaſe and Accuracy, ſhe hath furniſhed this Organ with no leſs than ſix Muſcles, to move it upward, downward, to the Right and Left, obliquely and round about.

I ſhall now conſider what Proviſion is made for the Defence and Security of this moſt excellent and uſeful Part.

Firſt, The Eyes are ſunk in a convenient Valley, *latent utiliter*, and are encompaſſed round with eminent Parts, as with a Rampart, *& excelſis undique partibus ſepiuntur*, * *Cic.* ſo are defended from the Strokes of any flat or broad Bodies. Above ſtand the Eye-Brows, to keep off any Thing from running down upon them, as Drops of Sweat from the Forehead, or Duſt, or the like. *Superiora ſuperciliis obducta ſudorem à capite & fronte defluentem repellunt.* Cic. Then follow the *Eye-lids*, which fence them from any ſudden and leſſer Stripes. Theſe alſo round the Edges are fortified with ſtiff Briſtles, as it were Paliſadoes, againſt the Incurſions of importunate Animals, ſerving partly as a Fan to ſtrike away Flies, or Gnats, or any another troubleſome Inſect; and partly to keep off ſuper-

* *De Natura Deorum, l.* 2.

ſuperfluous Light. *Munitæque ſunt palpebræ tanquam vallo pilorum, quibus & apertis oculis ſiquid inſideret repelleretur.* Idem, ibid. And becauſe it was neceſſary that Man and other Animals ſhould ſleep, which could not be ſo well done if the Light came in by the Windows of the Eyes, therefore hath Nature provided theſe Curtains to be then drawn to keep it out. And becauſe the outward Coat of the Eye ought to be pellucid, to tranſmit the Light, which, if the Eyes ſhould always ſtand open, would be apt to grow dry and ſhrink, and loſe their Diaphaneity, therefore are the Eye-lids ſo contrived, as often to wink, that ſo they may as it were glaze and varniſh them over with the Moiſture they contain, there being Glandules on purpoſe to ſeparate a Humour for that Uſe, and withal wipe off whatever Duſt, or Filth, may ſtick to them: And this, leſt they ſhould hinder the Sight, they do with the greateſt Celerity. *Cicero* hath taken Notice, that they are made very ſoft, leſt they ſhould hurt the Sight. *Molliſſimæ tactu nè læderent aciem, aptiſſimè facta & ad claudendas pupillas ne quid incideret, & ad aperiendas, idq; providit ut identidem fieri poſſet maxima cum celeritate.*

Secondly, If we conſider the Bulb, or Ball of the Eye, the exterior Membrane, or Coat thereof, is made thick, tough and ſtrong, that it is a very hard Matter to make a Rupture in it, and beſides ſo ſlippery, that it eludes the Force of any Stroke, to which alſo its globular Figure gives it a very great Advantage.

Laſtly, Becauſe for the Guidance and Direction of the Body in Walking, and any Exerciſe, it is neceſſary the Eye ſhould be uncovered, and expoſed to the Air at all Times, and in all Weathers, therefore the moſt wiſe Author of Nature hath provided for it a hot Bed of Fat, which fills up the Interſtices of the Muſcles; and beſides, made it more patient, and leſs ſenſible of Cold, than our other Parts; and tho' I cannot ſay with *Cicero*, abſolutely free from Danger or Harm by that Enemy, yet leaſt obnoxious to the Injuries thereof of any Part, and not at all, unleſs it be immoderate and extreme.

To all this I might add the Convenience of the Situation of the Eye in reſpect of its Proximity to the Brain, the Seat of Apprehenſion and Common Senſe: Whereas had it been farther removed, the *Optick Nerves* had been liable to many more Dangers and Inconveniencies than now they are.

Seeing then the Eye is compoſed of ſo great Variety of Parts, all conſpiring to the Uſe of Viſion, whereof ſome are abſolutely neceſſary, others very uſeful and convenient, none idle or ſuperfluous; and which is remarkable, many of them of a different Figure and Conſiſtency from any others in the Body beſides, as being tranſparent, which it was abſolutely neceſſary they ſhould be, to tranſmit the Rays of Light:

Who can but believe that this Organ was deſigned and made purpoſely for the Uſe for which it ſerves?

Neither is it to be eſteemed any Defect or Imperfection in the Eyes of Man, that they want the ſeventh Muſcle, or the nictating Membrane, which the Eyes of many other Animals are furniſhed withal; for though they be very uſeful, and in a Manner neceſſary to them, conſidering their Manner of living, yet they are not ſo to Man. To ſuch Beaſts as feed upon Graſs, and other Herbs, and therefore are forced to hold their Eyes long in a hanging Poſture, and to look downwards for the chooſing and gathering of their Food, the Seventh or Suſpenſory Muſcle is very uſeful, to enable them to do ſo without much Pain or Wearineſs; yet to Man, who doth not, nor hath any Occaſion, indeed cannot hold his Head, or look long downwards, it would be uſeleſs and ſuperfluous. As for the nictating Membrane, or *Periophthalmium*, which all Birds, and I think moſt Quadrupeds, are furniſhed with, I have been long in doubt what the Uſe of it might be; and have ſometimes thought it was for the more abundant Defence and Security of the Eye; but then I was puzzled to give any tolerable Account, why Nature ſhould be more ſolicitous for the Preſervation of the Eyes of Brutes than Men, and in this reſpect alſo to be a Step-mother to the moſt noble Creature.

But the Honourable * Author formerly mention'd, gives a probable Account why Frogs and Birds are furniſhed with ſuch a Membrane. Frogs, becauſe being Amphibious Animals, deſigned to paſs their Lives in watery Places, which for the moſt part abound with Sedges, and other Plants endowed with ſharp Edges, or Points; and the progreſſive Motion of this Animal being to be made not by Walking, but by Leaping, if his Eyes were not provided of ſuch a Sheath, he muſt either ſhut them, and ſo leap blindly, and by Conſequence dangerouſly, or by leaving them open, run a Venture to have the *Cornea* cut, prick'd, or otherwiſe offended by the Edges or Points of the Plants, or what may fall from them upon the Animal's Eye: Whereas this Membrane (being ſomething tranſparent as well as ſtrong) is like a Kind of Spectacle that covers the Eye without taking away the Sight. Birds are likewiſe furniſhed with it, becauſe being deſtinated to fly among the Branches of Trees and Buſhes, their Prickles, Twigs, Leaves, or other Parts, would be apt otherwiſe to wound or offend their Eyes. But yet ſtill we are to ſeek why it is given to other Quadrupeds, whoſe Eyes are in no ſuch Danger.

* *Boyle* of Final Cauſes, *p.* 53, 54.

Thirdly, The *Ear*, another Organ of Senſe, how admirable it is contrived for the receiving and conveying of Sounds. *Firſt*, There is the outward Ear, or *Auricula*, made hollow and contracted by Degrees to draw the Sound inward, to take in as much as may be of it, as we uſe a Funnel to pour Liquor into any Veſſel. And therefore if the *Auricula* be cut clear off, the Hearing is much impaired, and almoſt quite marred, as hath been by Experience found. From the *Auricula* is extended a ſmall, long, round Hole, inward into the Head, to intend the Motion, and ſo augment the Force of the Sound, as we ſee in a Shooting-Trunk, the longer it is to a certain Limit, the ſwifter and more forcibly the Air paſſes in it, and drives the Pellet. At the End of this Hole is a Membrane, faſtned to a round bony Limb, and ſtretched like the Head of a Drum, and therefore by Anatomiſts called alſo *Tympanum*, to receive the Impulſe of the Sound, and to vibrate or quaver according to its reciprocal Motions or Vibrations: The ſmall Ear-Bones being at the End faſtned to the *Tympanum*, and furniſhed with a Muſcle, ſerve for the Tenſion of that Membrane, or the Relaxation of it, according to the Exigency of the Animal; it being ſtretch'd to the utmoſt when it would hearken diligently to a lower or more diſtant Sound. Behind the Drum are ſeveral Vaults and Anfractuoſe Cavities in the Ear-Bone, filled only with what Naturaliſts call the Implanted Air; ſo to intend the leaſt Sound imaginable, that the Senſe might be affected with it; as we ſee in ſubterraneous Caves and Vaults, how the Sound is redoubled, and what a great Report it makes, however moderate it be: And becauſe it was for the Behoof of the *Animal*, that upon any ſudden Accident it might be awakened out of its Sleep, therefore were there no Shuts or Stopples made for the Ears, that ſo any loud or ſharp Noiſe might awaken it, as alſo a ſoft and gentle Voice of Murmur provoke it to Sleep. Now the Ears, for the Benefit and Conveniencies of the *Animal*, being always to ſtand open, becauſe there was ſome Danger that Inſects might creep in thereat, and eating their Way through the *Tympanum*, harbour in the Cavities behind it; therefore hath Nature loricated or plaiſtred over the Sides of the forementioned Hole with Ear-wax, to ſtop and entangle any Inſects that ſhould attempt to creep in there. But I muſt confeſs myſelf not ſufficiently to underſtand the Nature of Sounds, to give a full and ſatisfactory Account of the Structure and Uſes of all the Parts of the Ear. They who have a Mind to ſearch into the curious Anatomy and Uſe of this Part, may conſult Monſieur *du Verney*.

Fourthly, The next Part I ſhall take Notice of ſhall be the *Teeth*; concerning which I find Seven Obſervations in the honourable Mr. *Boyle*'s Treatiſe *Of Final Cauſes*, which I ſhall briefly recapitulate, and add one or two more.

I. That the Teeth alone, among the Bones, continue to grow in Length during a Man's whole Life, as appears by the unſightly Length of one Tooth, when its Oppoſite happens to fall, or be pulled out; which was moſt providently deſign'd to repair the Waſte that is daily made of them by the frequent Attrition in Maſtication. Here, by the by, I might adviſe Men to be careful how they attempt to cure this Blemiſh, by filing or cutting off the Head of ſuch an overgrown Tooth, leſt that befal them which happened to a certain Nun in *Padua*, who, upon cutting off a Tooth in that manner, was preſently convulſed, and fell into an Epilepſy, as *Bartholine* in his *Anatomy* reports.

II. That that Part of the Teeth which is extant above the Gums, is naked, and not inveſted with that ſenſible Membrane called *Perioſteum*, wherewith the other Bones are covered.

III. That the Teeth are of a cloſer and harder Subſtance than the reſt of the Bones, for the more eaſy Breaking and Comminution of the more ſolid Aliments, and that they might be more durable, and not ſo ſoon worn down by grinding the Food.

IV. That for the nouriſhing and cheriſhing theſe ſo neceſſary Bones, the All-wiſe Author of Things has admirably contrived an unſeen Cavity in each Side of the Jaw-bone, in which greater Chanel are lodged an Artery, a Vein, and a Nerve, which, through leſſer Cavities, as it were through Gutters, ſend their Twigs to each particular Tooth.

V. Becauſe Infants were for a conſiderable Time to feed upon Milk, which needs no Chewing, and leſt Teeth ſhould hurt the tender Nipples of the Nurſe, Nature hath deferred the Production of them for many Months in a humane *Fœtus*; whereas thoſe of divers other Animals, which are reduced to ſeek betimes Food that needs Maſtication, are born with them.

VI. The different Figure and Shape of the Teeth is remarkable. That the Fore-Teeth ſhould be formed broad, and with a thin and ſharp Edge, like Chizzels, to cut off and take away a Morſel from any ſolid Food, called therefore *Inciſores*. The next, one on each ſide, ſtronger, and deeper rooted, and more pointed, called therefore *Canini*, in *Engliſh* Eye-Teeth, to tear the more tough and reſiſting Sort of Aliments. The reſt called Jaw-Teeth, or Grinders, in *Latin*, *Molares*, are made flat and broad a-top, and withal ſomewhat uneven and rugged, that by their Knobs and little Cavities they may the better retain, grind, and commix the Aliments.

VI. Becauſe the Operations to be performed by the Teeth, oftentimes require a conſiderable Firmneſs and Strength, partly in the Teeth themſelves, partly in the Inſtruments which move the lower Jaw, which alone is moveable, Nature hath provided this with ſtrong Muſcles, to make it bear forcibly againſt the upper Jaw. And thus not only placed each Tooth in a diſtinct Cavity of the Jaw-bone, as it were in a cloſe, ſtrong, and deep Socket, but has furniſhed the ſeveral Sorts of Teeth with Holdfaſts ſuitable to the Streſs, that by reaſon of their different Offices they are to be put to. And therefore, whereas the *Cutters* and *Eye-Teeth* have uſually but one Root, (which in theſe laſt named is wont to be very long) the *Grinders*, that are employed to crack Nuts, Stones of Fruit, Bones, or other hard Bodies, are furniſhed with three Roots, and in the upper Jaw often with four, becauſe theſe are pendulous, and the Subſtance of the Jaw ſomewhat ſofter.

VIII. The Situation of the Teeth is moſt convenient, *viz.* the *Molares*, or *Grinders*, behind, neareſt the Center of Motion, becauſe there is a greater Strength, or Force, required to chew the Meat, than to bite a Piece, and the *Cutters* before, that they may be ready to cut off a Morſel from any ſolid Food, to be tranſmitted to the *Grinders*.

IX. It is remarkable, that the Jaw in Men, and ſuch Animals as are furniſhed with Grinders, hath an oblique or tranſverſe Motion, which is neceſſary for Chewing and Comminution of the Meat; which it is obſerved not to have in thoſe Animals that want the *Molares.*

Now if (as *Galen* ſaith) he that ſhall marſhal a Company but of Thirty-two Men in due Order, is commended for a skilful and induſtrious Perſon, ſhall we not admire Nature which hath ſo skilfully ranked and diſpoſed this Quire of our Teeth?

Fifthly, The *Tongue* is no leſs admirable for the Contexture, and manifold Uſes of it. *Firſt*, It is the Organ of Taſting; for being of a ſpungey Subſtance, the ſmall Particles of our Meat and Drink being mingled with the *Saliva*, eaſily inſinuate themſelves into the Pores of it, and ſo do either gratefully affect it, or harſhly grate upon it, accordingly as they are figured and moved; and hereby we diſcern what is convenient or inconvenient for our Nouriſhment. It helps us likewiſe in the Chewing and Swallowing of our Meat: And, *Laſtly*, It is the main Inſtrument of Speaking, a Quality ſo peculiar to Man, that no Beaſt could ever attain to it. And although Birds have been taught to form ſome Words, yet they have been but a few, and thoſe learnt with great Difficulty; but what is the Chief, the Birds underſtand not the Meaning of them, nor uſe them as Signs of Things, or their own Conceptions of them; though they may uſe them as Expreſſions of their Paſſions: As Parrots having been uſed to be fed at the Prolation of certain Words, may afterwards, when they are hungry, pronounce the ſame. For this *Des Cartes* makes his main Argument, to prove, that Brutes have no Cogitation, becauſe the higheſt of them could never be brought to ſignify their Thoughts, or Conceptions, by any artificial Signs, either Words, or Geſtures, (which, if they had any, they would, in all likelihood, be forward enough to do) whereas all Men, both Fools, and Mutes, make uſe of Words, or other Signs, to expreſs their Thoughts, about any Subjects that preſent themſelves; which Signs alſo have no reference to any of their Paſſions. Whereas the Signs that Brute Animals may be taught to uſe, are no other than ſuch as are the Motions of ſome of their Paſſions, Fear, Hope, Joy, *&c.* Hence ſome of the *Jewiſh* Rabbins did not ſo abſurdly define a Man * *Animal loquens*, a ſpeaking Creature. Having had occaſion juſt now to mention the *Saliva*, or Spittle, I am put in mind of the eminent Uſe of this Humour, which is commonly taken for an Excrement. Becauſe a great Part of our Food is dry; therefore Nature hath provided ſeveral Glandules to ſeparate this Juice from the Blood, and no leſs than four Pair of Chanels to convey it into the Mouth, which are of late Invention, and called by Anatomiſts *Ductus Salivales*, through which the *Saliva* diſtilling continually, ſerves well to macerate and temper our Meat, and make it fit to be chewed and ſwallowed. If a copious Moiſture did not, by theſe Conduit-Pipes, inceſſantly flow down into the Mouths of *Horſes* and *Kine*, how were it poſſible they ſhould for a long time together grind and ſwallow ſuch dry Meat as Haw and Straw? Moreover, it is uſeful not only in the Mouth, but in the Stomach too, to promote Concoction, as we have already noted.

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* חֽימְרַבֵת

Sixthly, To the Mouth ſucceeds the *Wind-Pipe*, no leſs wonderful in its Conformation; for becauſe continual Reſpiration is neceſſary for the Support of our Lives, it is made with annulary Cartilages to keep it conſtantly open, and that the Sides of it may not flag and fall together. And leſt when we ſwallow, our Meat, or Drink, ſhould fall in there, and obſtruct it, it hath a ſtrong Shut, or Valve, called *Epiglottis*, to cover it cloſe, and ſtop it when we ſwallow: For the more convenient bending of our Necks, it is not made of one entire continued Cartilage, but of many annular ones join'd together by ſtrong Membranes, which Membranes are muſcular, compounded of ſtreight and circular Fibres, for the more effectual Contraction of the Wind-Pipe in any ſtrong or violent Expiration or Coughing. And leſt the Aſperity or Hardneſs of theſe Cartilages ſhould hurt the *Oeſophagus*, or Gullet, which is tender, and of a ſkinny Subſtance, or hinder the Swallowing of our Meat, therefore theſe annulary Griſtles are not made round, or entire Circles; but where the Gullet touches the Wind-Pipe, there to fill up the Circle, is only a ſoft Membrane, which may eaſily give Way to the Dilation of the Gullet. And to demonſtrate that this was deſignedly done for this End and Uſe, ſo ſoon as the Wind-Pipe enters the Lungs, its Cartilages are no longer deficient, but perfect Circles, or Rings, becauſe there was no neceſſity they ſhould be ſo, but it was more convenient they ſhould be entire. *Laſtly*, For the various Modulation of the Voice, the Upper-end of the Wind-Pipe is endued with ſeveral Cartilages and Muſcles, to contract, or dilate it, as we would have our Voice flat, or ſharp; and, moreover, the Whole is continually moiſtned with a glutinous Humour, iſſuing out of the ſmall Glandules that are upon its inner Coat, to fence it againſt the ſharp Air received in, or Breath forced out; yet is it of quick and tender Senſe, that it may be eaſily provoked to caſt out by Coughing, whatever may fall into it from without, or be diſcharged into it from within.

It is alſo very remarkable which *Caſpar Bartholine* hath obſerved in the Gullet, that where it perforateth the Midriff, the carneous Fibres of that Muſcular Part are inflected and arcuate, as it were a *Spincter* embracing and cloſing it faſt, by a great Providence of Nature, leſt, in the perpetual Motion of the ſaid Midriff, the upper Orifice of the Stomach ſhould gape, and caſt out the Victuals as faſt as it received it.

Seventhly, The *Heart*, which hath been always eſteemed, and really is, one of the principal Parts of the Body, the *primum vivens*, & *ultimum moriens*, the firſt Part that quickens, and the laſt that dies, by its inceſſant Motion diſtributing the Blood, the Vehicle of Life, and with it the Vital Heat and Spirits, throughout the whole Body, whereby it doth continually irrigate, nouriſh, and keep hot, and ſupple all the Members. Is it not admirable, That from this Fountain of Life and Heat, there ſhould be Chanels and Conduit-Pipes, to every, even the leaſt and moſt remote, Part of the Body? Juſt as if from one Water-houſe, there ſhould be Pipes conveying the Water to every Houſe in a Town, and to every Room in each Houſe; or from one Fountain in a Garden, there ſhould be little Chanels or Dikes cut to every Bed, and every Plant growing therein, as we have ſeen more than once done beyond the Seas. I confeſs, the Heart ſeems not to be deſigned to ſo noble an Uſe as is generally believed, that is, to be the Fountain or Conſervatory of the vital Flame, and to inſpire the Blood therewith; (for the Lungs ſerve rather for the Accenſion, or maintaining that Flame, the Blood receiving there from the Air thoſe Particles which are one Part of the *Pabulum*, or Fewel thereof, and ſo impregnated, running back to the Heart) but to ſerve as a Machine to receive the Blood from the Veins, and to force it out by the Arteries thro' the whole Body, as a Syringe doth any Liquor, though not by the ſame Artifice: And yet this is no ignoble Uſe, the Continuance of the Circulation of the Blood being indiſpenſably neceſſary for the quickening and enlivening of all the Members of the Body, and ſupplying of Matter to the Brain, for the Preparation of the Animal Spirits,

rits, the Inſtruments of all Senſe and Motion. Now for this Uſe of receiving and pumping out of the Blood, the Heart is admirably contrived. For, *Firſt*, being a Muſcular Part, the Sides of it are compos'd of two Orders of Fibres, running circularly, or ſpirally, from Baſe to Tip, contrarily one to the other, and ſo being drawn, or contracted contrary-ways, do violently conſtringe and ſtraiten the Ventricles, and ſtrongly force out the Blood, as we have formerly intimated. Then the Veſſels we call *Arteries*, which carry from the Heart to the ſeveral Parts, have Valves which open outwards like Trap-doors, and give the Blood a free Paſſage out of the Heart, but will not ſuffer it to return back again thither; and the *Veins*, which bring it back from the ſeveral Members to the Heart, have Valves, or Trap-doors, which open inwards, ſo as to give way unto the Blood to run into the Heart, but prevent it from running back again that Way. Beſides, the Arteries conſiſt of a Quadruple Coat, the Third of which is made up of Annular, or Orbicular carneous Fibres to a good Thickneſs, and is of a Muſcular Nature, after every Pulſe of the Heart, ſerving to contract the Veſſel ſucceſſively with incredible Celerity; ſo by a kind of periſtaltick Motion, impelling the Blood onwards to the capillary Extremities, and through the Muſcles, with great Force and Swiftneſs. So the Pulſe of the Arteries is not only cauſed by the Pulſation of the Heart, driving the Blood through them, in manner of a Wave, or Fluſh, as *Des Cartes*, and others, would have it; but by the Coats of the Arteries themſelves, which the Experiments of a certain * *Lovain* Phyſician (the firſt whereof is *Galen*'s) do, in my Opinion, make good againſt him. " Firſt, *ſaith he*, " if you ſlit the Artery, and thruſt into it a " Pipe, ſo big as to fill the Cavity of it, and " caſt a ſtrait Ligature upon that Part of the " Artery containing the Pipe, and ſo bind it faſt " to the Pipe; notwithſtanding the Blood hath " free Paſſage through the Pipe, yet will not the " Artery beat below the Ligature; but do but " take off the Ligature, it will commence again " to beat immediately." But becauſe one might be ready to reply to this Experiment, that the Reaſon why when bound it did not beat, was, becauſe the Current of the Blood being ſtraitned by the Pipe, when beneath the Pipe it came to have more Liberty, was not ſufficient to ſtretch the Coat of the Artery, and ſo cauſe a Pulſe; but when the Ligature was taken off, it might flow between the encloſed Tube, and the Coat of the Artery: Therefore he adds another, which clearly evinces, that this could not be the Reaſon, but that it is ſomething flowing down the Coats of the Artery that cauſes the Pulſe: That is, if you ſtraiten the Artery never ſo much, provided the Sides of it do not quite meet, and ſtop all Paſſage of the Blood, the Veſſel will, notwithſtanding, continue ſtill to beat below, or beyond the Coractation. So we ſee ſome Phyſicians, both Ancient, (as *Galen*)

* Cartes *Ep. V.* 1. *Ep.* 77. *& Seq.*

len) and Modern, were of Opinion, that the Pulſe of the Arteries was owing to their Coats; though the firſt, that I know of, who obſerved the third Coat of an Artery to be a muſcular Body, compoſed of annular Fibres, was Dr. *Willis.* This mention of the periſtaltick Motion, puts me in mind of an ocular Demonſtration of it, in the Gullet of Kine when they chew the Cud, which I have often beheld with Pleaſure. For, after they have ſwallowed one Morſel, if you look ſtedfaſtly upon their Throat, you will ſoon ſee another aſcend, and run pretty ſwiftly all along the Throat up to the Mouth, which it could not do, unleſs it were impelled by the ſucceſſive Contraction, or periſtaltick Motion of the Gullet, continually following. And it is remarkable, that theſe ruminant Creatures have a Power by the *Imperium* of their Wills, of directing this periſtaltick Motion upwards or downwards. I ſhall add no more concerning the Heart, but that it, and the Brain, do *mutuas operas tradere*, enable one another to work: For, *Firſt*, the Brain cannot itſelf live, unleſs it receive continual Supplies of Blood from the Heart, but leſs can it perform its Functions of preparing and diſtributing the Animal Spirits; nor the Heart pulſe, unleſs it receives Spirits, or ſomething elſe that deſcends from the Brain by the Nerves. For do but cut aſunder the Nerves that go from the Brain to the Heart, the Motion thereof, in moſt perfect and hot Creatures, ceaſeth immediately. Which Part began this Round is the Queſtion.

I find, in the *Philoſophical Tranſactions*, Numb. 280. ſome notable Obſervations of the famous Anatomiſt Mr. *William Cowper*, concerning the Artifice of Nature, in regulating the Motion of the Blood in the Veins and Arteries, to aſſiſt and promote it in the one, and moderate it in the other, which I ſhall give you in his own Words:

" As the *Arteries* (*ſaith he*) are known to ex-
" port the Blood, ſo the *Veins* to carry it back
" again to the Heart; but having already deſcri-
" bed their Extremities, we come now to the
" large Trunks of the *Veins*, and here, as in the
" *Arteries*, we find the common Practice of Na-
" ture, in diſpoſing the Branches of Veins to diſ-
" charge the refluent Blood into the next adja-
" cent Trunk, and ſo on to the Heart. As the
" *Arteries* afford abundance of Inſtances of Checks
" given to the Velocity of the Current of Blood
" through ſeveral Parts, ſo the *Veins* ſupply us
" with as many Artifices, to aſſiſt its regular
" Return to the *Heart*, as well as favour thoſe
" Contrivances in the *Arteries*.

" The *carotid*, *vertebral*, and *ſplenick Arteries*,
" are not only variouſly contorted, but alſo here
" and there dilated to moderate the Motion of
" the Blood; ſo the *Veins* that correſpond to
" thoſe *Arteries* are alſo variouſly dilated. The
" Beginnings of the internal *Jugulars* have a bul-
" bous Cavity, which are *diverticula* to the re-
" fluent Blood, in the *Sinus's* of the *Dura Mater*,

" left it ſhould deſcend too faſt into the *Jugu-* " *lars.* The like has been taken Notice of by " Dr. *Lower*, in the *Vertebral Sinus's.* The *Sple-* " *nick Vein* has divers Cells opening into it, near " its Extremities in Humane Bodies, but in " Quadrupeds, the Cells open into the Trunks " of the Splenick Veins.

" The *Spermatick* Veins do more than equal " the Length of the Arteries of the *Teſtes* in Men; " their various Diviſions, and ſeveral Inoſcula- " tions, and their Valves are admirably contri- " ved to ſuſpend the Weight of the Blood, in or- " der to diſcharge it into the larger Trunks of " the *Veins*; and were it not that the refluent " Blood from the *Teſtes*, is a *Pondus* to the in- " fluent Blood from the *Arteries*, and ſtill leſſens " its Current in the *Teſtes*, theſe Spermatick " Veins, like thoſe of other Parts, might have " diſcharged the Blood into the next adjacent " Trunk.

" Who can avoid Surprize at the Art of Na- " ture, in contriving the *Veins* that bring Part of " the refluent Blood from the lower Parts of the " Body, when they conſider the Neceſſity of " placing the Humane Heart, as well as that of " moſt Quadrupeds, ſo far from the Center of " the Body towards its upper Part. It is for that " End neceſſary, that the large Trunks of the " *Veins* and *Arteries* ſhould not aſſociate each " other. For if all the Blood ſent to the lower " Parts, by the deſcending Trunk of the *Aorta*, " ſhould return to the Heart again by one ſingle " Trunk, (as it is ſent out from thence) the

“ Weight of ſo much Blood in the aſcending “ Trunk of the *Vena Cava*, would oppoſe all the “ Force the Heart could give it from the Arte- “ ries, and hinder its Aſcent. For this Reaſon “ the *Vena Azygos*, or *ſine Pari*, is contrived to “ convey the Blood ſent to the Muſcles of the “ Back and *Thorax*, into the deſcending Trunk “ of the *Vena Cava* above the Heart. Hence it's “ evident, that more Blood comes into the Heart “ by the deſcending or upper Trunk of the *Vena* “ *Cava*, than paſſes out by the aſcending Trunk “ of the *Aorta*. Nor does the Quantity of Blood “ convey'd to the Heart by the ſuperior Trunk “ of the *Cava*, ſeem, without ſome other Deſign “ in Nature beſides tranſporting it thither, to free “ the inferior Trunk from its Weight. But per- “ haps it was neceſſary ſo much Blood ſhould “ be ready there to join with the *Chyle*, for its “ better Mixture, before it reaches the right Au- “ ricle of the Heart.” *So far Mr.* Cowper.

Eighthly, The next Part I ſhall treat of ſhall be the *Hand*, this ὄργανον ὀργάνων, or ſuperlative Inſtrument, which ſerves us for ſuch a Multitude of Uſes, as it is not eaſy to enumerate; whereto, if we conſider the Make and Structure of it, we ſhall find it wonderfully adapted. *Firſt*, It is divided into four Fingers bending forward, and one oppoſite to them bending backwards, and of greater Strength than any of them ſingly, which we call the Thumb, to join with them ſeverally, or united; whereby it is fitted to lay hold of Objects of any Size, or Quantity. The leaſt Things, as any ſmall ſingle Seed, are taken up by the Thumb and Fore-finger; thoſe a little greater, by the Thumb and two Fingers, which alſo we chiefly employ to manage the Needle in Sowing, and the Pen in Writing: When we would take up a greater Quantity of any Thing, we make uſe of the Thumb, and all the Fingers. Sometimes we uſe one Finger only, as in pointing at any Thing, picking Things out of Holes, or long and narrow Veſſels; ſometimes all ſeverally at one time, as in ſtopping the Strings when we play upon any muſical Inſtruments. *Secondly*, The Fingers are ſtrengthened with ſeveral Bones, jointed together for Motion, and furniſhed with ſeveral Muſcles and Tendons, like ſo many Pullies to bend them circularly forwards; which is moſt convenient for the firm holding and griping of any Object: Which of how great, conſtant, and neceſſary Uſe it is in pulling, or drawing, but eſpecially in taking up, and retaining any Sort of Tool, or Inſtrument, to work withal, in Huſbandry, and all mechanick Arts, is ſo obvious to every Man's Obſervation, that I need not ſpend Time to inſtance in Particulars: Moreover, the ſeveral Fingers are furniſhed with ſeveral Muſcles, to extend and open the Hand, and to move to the Right and Left: And ſo this Diviſion and Motion of the Fingers doth not hinder, but that the whole Hand may be employed, as if it were all of a Piece; as we ſee it is, either expanded, as in ſtriking out, ſmoothing and folding up of Clothes, and ſome mechanick Uſes; or contracted, as in Fighting, kneeding of Dough, and the like. It is alſo notable, and indeed wonderful, that the Tendons, bending the middle Joint of the Fingers, ſhould be perforated to give Paſſage to the Tendons of the Muſcles which draw the uppermoſt Joints, and all bound down cloſe to the Bone with ſtrong Fillets, leſt they ſhould ſtart up, and hinder the Hand in its Work, ſtanding like ſo many Bow-ſtrings. *Thirdly*, The Fingers-Ends are ſtrengthened with Nails, as we fortify the Ends of our Staves, or Forks, with Iron-Hoops, or Ferules; which Nails ſerve not only for Defence, but for Ornament, and many Uſes. The Skin upon our Fingers-Ends is thin, and of moſt exquiſite Senſe, to help us judge of any Thing we handle. If now I ſhould go about to reckon up the ſeveral Uſes of this Inſtrument, Time would ſooner fail me than Matter. By the Help of this we do all our Works, we build ourſelves Houſes to dwell in; we make ourſelves Garments to wear; we plow and ſow our Grounds with Corn, dreſs and cultivate our Vineyards, Gardens, and Orchards, gather and lay up our Grain, and Fruits, we prepare and make ready our Victuals: Spinning, Weaving, Painting, Carving, Engraving, and that divinely invented Art of Writing, whereby we tranſmit our own Thoughts to Poſterity, and converſe with, and participate the Obſervations and Inventions of them that are long ago Dead, all performed be this. This is the only Inſtrument for all Arts whatſoever; no Improvement to be made of any Experimental Knowledge without it. Hence (as *Ariſtotle* ſaith well) they do amiſs that complain, that Man is worſe dealt with by Nature than any other Creatures; whereas they have ſome Hair, ſome Shells, ſome Wool, ſome Feathers, ſome Scales, to defend themſelves from the Injuries of the Weathe: Man alone is born Naked, and without all Covering; whereas, they have natural Weapons to defend themſelves, and offend their Enemies, ſome Horns, ſome Hoofs, ſome Teeth, ſome Talons, ſome Claws, ſome Spurs and Beaks; Man hath none of all theſe, but is weak and feeble, and unarmed ſent into the World. Why, a Hand, with Reaſon to uſe it, ſupplies the Uſes of all theſe, that's both a Horn, and a Hoof, and a Talon, and a Tusk, *&c.* becauſe it enables us to uſe Weapons of theſe, and other Faſhions, as Swords, and Spears, and Guns. Beſides, this Advantage a Man hath of them, that whereas they cannot at Pleaſure change their Coverings, or lay aſide their Weapons, or make uſe of others as Occaſion ſerves, but muſt abide Winter and Summer, Night and Day, with the ſame Clothing on their Backs, and ſleep with their Weapons upon them; a Man can alter his Clothing according to the Exigency of the Weather, go warm in Winter, and cool in Summer, cover up himſelf hot in the Night, and lay aſide his Clothes in the Day, and put on or off more or fewer, according

cording as his Work and Exerciſe is: And can, as Occaſion requires, make uſe of divers Sorts of Weapons, and Choice of ſuch at all Turns, as are moſt proper and convenient; whereby we are enabled to ſubdue and rule over all other Creatures; and uſe for our own Behoof thoſe Qualities wherein they excel, as the Strength of the Ox, the Valour and Swiftneſs of the Horſe, the Sagacity and Vigilancy of the Dog, and ſo make them as it were our own. Had we wanted this Member in our Bodies, we muſt have lived the Life of Brutes, without Houſe or Shelter, but what the Woods and Rocks would have afforded; without Clothes or Covering; without Corn, or Wine, or Oil, or any other Drink but Water; without the Warmth and Comfort, or other Uſes of Fire, and ſo without any Artificial bak'd, boil'd, or roaſt Meats; but muſt have ſcrambled with the wild Beaſts for Crabs, and Nuts, and Acorns, and ſuch other Things as the Earth puts forth of her own Accord. We had laid open and expoſed to Injuries, and had been unable to reſiſt or defend ourſelves againſt almoſt the weakeſt Creature.

The remaining Parts I ſhall but briefly run over;

That the *Back-Bone* ſhould be divided into ſo many Vertebres for commodious bending, and not be one entire rigid Bone, which being of that Length would have been often in Danger of ſnapping in ſunder: That it ſhould be made tapering in Form of a Pillar, the lower

Vertebres being the broadeſt and largeſt, and the Superior in order, leſſer and leſſer, for the greater Firmneſs and Stability of the Trunk of the Body: that the ſeveral Vertebres ſhould be ſo elegantly and Artificially compacted and joined together, that they are as ſtrong and firm, as if they were but one Bone: That they ſhould be all perforated in the Middle with a large Hole for the Spinal Marrow or Pith to paſs along; and each Particular have a Hole on each Side to tranſmit the Nerves to the Muſcles of the Body, to convey both Senſe and Motion: That by reaſon of the forementioned cloſe Connexion of the Vertebres, it ſhould be ſo formed, as not to admit any great Flexture or Receſs from a Right Line, any Angular, but only a moderate Circular Bending; leſt the Spinal Pith ſhould be compreſſed, and ſo the free Intercourſe or Paſſage of the Spirits to and fro be ſtop'd.

One Obſervation relating to the Motion of the Bones in their Articulations, I ſhall here add, that is, the Care that is taken, and the Proviſion that is made, for the eaſy and expediate Motion of them; there being to that Purpoſe a twofold Liquor prepared for the Inunction and Lubrification of their Heads or Ends; 1. An Oily one, furniſhed by the Marrow; 2. A Mucilaginous, ſupplied by certain Glandules ſeated in the Articulations, both which together make up the moſt apt and proper Mixture for this Uſe and End that can be invented or thought upon. For not only both the Ingredients are of a lubricating Nature; but there is this Advantage gained from their Compoſition, that they do mutually improve one another: For the Mucilage adds to the Lubricity of the Oil, and the Oil preſerves the Mucilage from Inſpiſſation, and contracting the Conciſtency of a Gelly: Now this Inunction is uſeful, indeed neceſſary, for three Ends chiefly.

1. For the facilitating of Motion. For tho' the Ends of the Bones are very ſmooth, yet were they dry, they could not with that Readineſs and Eaſe, nay, not without great Difficulty, yield to and obey the Plucks and attractions of the Motory Muſcles; as we ſee Clocks and Jacks, though the Screws and Teeth of the Wheels and Nuts be never ſo ſmooth and poliſh'd, yet if they be not oil'd, will hardly move, tho' you clog them with never ſo much Weight; but if you apply but a little Oil, they preſently whirl about very ſwiftly with the tenth Part of the Force.

2. For preſerving the Ends of the Bones from an Incaleſcency, which, they being hard and ſolid Bodies, would neceſſarily contract from a ſwift and long continuing Motion; ſuch as that of Running, or Mowing, or Threſhing, or Sawing, and the like, if they immediately touched and rubbed againſt one another with that Force they muſt needs do; eſpecially in running, the whole Weight of the Body bear-

ing upon the Joints of the Thighs and Knees: So we ſee in the Wheels of Waggons or Coaches, the Hollows of the Naves, by their ſwift Rotations on the Ends of the Axle-trees, produce a Heat, ſometimes ſo intenſe, as to ſet them on fire, to prevent which, they ſtand in need to be frequently anointed or beſmear'd with a Mixture of Greaſe and Tar, imitating the forementioned natural Compoſition of Oil and Mucilage. Nay, Bodies ſofter a great deal than Metals, contract a great Heat by Attrition; as is evident from thoſe black circular Lines we ſee on Boxes, Diſhes, and other turned Veſſels of Wood, which are the Effects of Ignition, cauſed by the Preſſure of an edged Stick upon the Veſſel turned nimbly in the Lathe. And if there had not been a Proviſion in the Joints againſt ſuch a preternatural Incaleſcence upon their violent Motion, this would have made a ſlothful World, and confin'd us to leiſurely and deliberate Movements, when there were the moſt urgent and haſty Occaſions to quicken us.

3. For the preventing of Attrition, and wearing down the Ends of the Bones by their Motion, and rubbing one againſt another, which is ſo violent and laſting ſometimes, that it is a Wonder any Inunction ſhould ſuffice, to ſecure their Heads from Waſting and Conſumption. I have often ſeen the Tops of the Teeth (which are of a harder Subſtance than the reſt of the Bones) worn off by Maſtication, in Perſons

who have loſt moſt of their Grinders, and been compelled conſtantly to make uſe of three or four only in chewing, ſo low, that at laſt the inward Marrow and Nerve lay bare, and they could no longer, for Pain, make uſe of them. So that had there not been this Proviſion made for the anointing the Bones, the curious Workmanſhip of Nature in adapting them ſo exactly one to another, as was moſt fit for the eaſy Performance of all thoſe Motions to which they were deſtined, would not ſuffice for Uſe; But the ſtirring Part of Mankind would ſoon find themſelves fitter for an Hoſpital, than for Action, and the Purſuit of Buſineſs.

* Mr. *Clopton Havers.*

Theſe Obſervations I acknowledge myſelf to have borrowed of a late ingenious * Writer of *Oſteology*, who thus concludes his Diſcourſe upon this Subject. *And here we cannot avoid the Notice of the viſible Footſteps of an Infinite Reaſon, which as they are deeply impreſſed upon the Univerſe, ſo more eſpecially on the Senſible Parts of it in thoſe rational Contrivances which are found in Animals: And we can never ſufficiently admire the Wiſdom and Providence of our great Creator, who has given all Parts in theſe animated Beings, not only ſuch a Structure as renders them fit for their neceſſary Motions, and deſigned Functions, but withal the Benefit and Advantage of whatever may preſerve them, or facilitate their Action.*

Moreover, the Artifice of Nature is wonderful in the Conſtruction of the Bones that are to ſupport the Body, and to bear great Burdens, or to be employed in ſtrong Exerciſes, they being made hollow, for Lightneſs and Stiffneſs. For we have before noted, a Body that is hollow may be demonſtrated to be more rigid and inflexible, than a ſolid one of the ſame Subſtance and Weight. So that here is Proviſion made for the Stiffneſs and Lightneſs of the Bones. But the Ribs, which are not to bear any great Weight, or to be ſtrongly exerciſed, but only to fence the Breaſt, have no Cavity in them, and towards the fore Part or Breaſt are broad and thin, that ſo they might bend and give way without Danger of Fracture; when bent returning by their elaſtick Property to their Figure again. Yet is not the Hollow of the Bones altogether uſeleſs but ſerves to contain the Marrow; which ſupplies an Oil for the Maintaining and Inunction of the Bones and Ligaments, and ſo facilitating their Motion in the Articulations; and particularly (which we mentioned not before) of the Ligaments, preſerving them from Dryneſs and Rigidity, and keeping them ſupple and flexible, and ready to comply with all the Motions and Poſtures of that moveable Part to which they appertain: And laſtly, to ſecure them from Diſruption, which, as ſtrong as they are, they would be in ſome Danger of, upon a great and ſuddain Stretch or Contortion, if they were dry, *&c.* See more to this Purpoſe in the Treatiſe fore-quoted, *P.* 183.

That whereas the *Breaſt* is encompaſſed with Ribs, the *Belly* is left free; that it might give Way to the Motion of the Midriff in Reſpiration; and to the neceſſary Reception of Meat and Drink; as alſo for the convenient Bending of the Body; and in Females, for that extraordinary Extention that is requiſite in the Time of their Pregnancy.

That the Lungs ſhould be made up of ſuch innumerable Air-Pipes and Veſicles, interwoven with Blood-Veſſels, in order to purify, ferment, or ſupply the ſanguineous Maſs with Nitro-Ærial Particles, which ruſh in by their Elaſtick Power upon the Muſcular Extenſion of the Thorax, and ſo feed the Vital Flame and Spirits; for upon obſtructing this Communication, all is preſently extinct, no Circulation, no Motion, no Heat, nor any Sign of Life remains.

That the *Stomach* ſhould be membranous, and capable of Dilatation and Contraction, according to the Quantity of Meat contained in it; that it ſhould be ſituate under the Liver, which by its Heat might cheriſh it, and contribute to Concoction; that it ſhould be endued with an acid or glandulous Ferment, or ſome corruptive Quality, for ſo ſpeedy a Diſſolution of the Meat, and Preparation of Chyle; that after Concoction it ſhould have an Ability of contracting itſelf, and turning out the Meat.

That the *Guts* ſhould immediately receive it from the *Phylorous*, farther elaborate, prepare

pare, and ſeparate it, driving by their Periſtaltick Motion the Chyle into the Lacteals, and the excrementitious Parts to the Podex, from whence there is no Regreſs, unleſs when the Valve of the Colon is torn and relax'd: But for the curious Structure of theſe Parts, ſee more in *Kerkringius*, *Gliſſon*, *Willis*, and *Peyer*.

That the Bladder ſhould be made of a membranous Subſtance, and ſo extremely dilatable, for receiving and containing the Urine, till Opportunity of emptying it; that it ſhould have Shuts for the Ends of the Ureters ſo artificially contrived as to give the Urine free Entrance, but to ſtop all Paſſage backward, ſo that they will not tranſmit the Wind, though it be ſtrongly blown and forced in.

That the *Liver* ſhould continually ſeparate the Choler from the Blood, and empty it into the Inteſtines, where there is good Uſe for it, not only to provoke Dejection, but alſo to attenuate the Chyle, and render it ſo ſubtle and fluid, as to enter in at the Orifices of the Lacteous Veins.

That in the *Kidneys* there ſhould be ſuch innumerable little Siphons, or Tubes, conveying the Urinoſe Particles to the Pelves and Ureters, firſt diſcover'd by *Bellini*, and illuſtrated by *Malpighy*; that indeed all the Glands of the *Body* ſhould be Congeries of various Sorts of Veſſels cur'd, circumgyrated, and complicated together, whereby they give the Blood time to ſtop and ſeparate through the Pores of the

Capillary Veſſels into the Secretory ones, which afterwards all exonerate themſelves into one common Ductus; as may be ſeen in the Works of Dr. *Wharton*, *Graaf*, *Bartholine*, *Rudback*, *Bilſius*, *Malpighi*, *Nuck*, and others. That the Glands ſhould ſeparate ſuch Variety of Humours, all different in Colour, Taſte, Smell, and other Qualities.

Finally, That all the Bones, and all the Muſcles, and all the Veſſels of the Body ſhould be ſo admirably contrived, and adapted, and compacted together for their ſeveral Motions and Uſes, and that moſt *Geometrically*, according to the ſtricteſt Rules of *Mechanicks*; that if in the whole Body you change the Figure, Situation, and Conjunction but of one Part, if you diminiſh or increaſe the Bulk and Magnitude; in fine, if you endeavour any Innovation, or Alteration, you marr and ſpoil, inſtead of mending. How can all theſe Things put together, but beget Wonder and Aſtoniſhment?

In the Muſcles alone there ſeems to be more Geometry, than in all the artificial Engines in the World; and therefore the different Motions of Animals, are a Subject fit only for the great Mathematicians to handle; amongſt whom, *Steno*, Dr. *Croon*, and above all, *Alphonſo Borelli*, have made their Eſſays towards it.

That under one Skin there ſhould be ſuch infinite Variety of Parts, variouſly mingled, hard with ſoft, fluid with fix'd, ſolid with hollow, thoſe in Reſt with thoſe in Motion;

ſome with Cavities, as Morteſſes to receive, others with Tenons to fit thoſe Cavities; all theſe ſo pack'd and thruſt ſo cloſe together, that there is no unneceſſary Vacuity in the whole Body, and yet ſo far from claſhing, or interfering one with another, or hindring each others Motions, that they do all friendly conſpire, all help and aſſiſt mutually one the other, all concur in one general End and Deſign, the Good and Preſervation of the Whole, are certainly Arguments and Effects of Infinite Wiſdom and Council; ſo that he muſt needs be worſe than mad that can find in his Heart to imagine all theſe to be caſual and fortuitous, or not provided and deſigned by a moſt Wiſe and Intelligent Cauſe.

Every Part is cloath'd, join'd together, and corroborated by Membranes, which upon ſeveral Occaſions (as Extravaſations of Humours, Compreſſions, or Obſtructions of Veſſels) are capable of a prodigious Extenſion, as we ſee in the Hydatides of the Female Teſticles, or Ovaries, in Hydropical Tumors of the *Lymphæducts*, of the *Scrotum* and *Peritonæum*, out of the laſt of which alone twenty and even forty Gallons of Water have been drawn by a *Paracenteſis*, or Tapping, for which we have the undoubted Authority of *Tulpius*, *Meekren*, *Pechlin*, *Blaſius*, and other Medical Writers. What vaſt Sacks and Bags are neceſſary to contain ſuch a Collection of Water, which ſeems to iſſue from the *Lymphæducts*, either delacerated, or obſtructed, and exonerating themſelves into the Foldings, or between the Duplicatures of the Membranes?

Thoſe Parts which one would think were of little Uſe in the Body, ſerving chiefly to fill up empty Spaces, as the Fat, if examined ſtrictly, will be found very beneficial and ſerviceable to it. 1. To cheriſh and keep it warm, by hindring the Evaporation of the hot Streams of Blood, as Clothes keep us warm in Winter, by reflecting and doubling the Heat. 2. To nouriſh and maintain the Body for ſome Time when Food is wanting, ſerving as Fewel to preſerve and continue the natural Heat of the Blood, which requires an oily, or ſulphureous *Pabulum*, as well as Fire. Hence, upon long Abſtinence and Faſting, the Body grows lean. Hence alſo ſome Beaſts, as the *Marmotto*, or *Mus Alpinus*, a Creature as big, or bigger than a *Rabbet*, which abſconds all Winter, doth (as *Hildanus* tells us) live upon its own Fat. For in the Autumn, when it ſhuts itſelf up in its Hole (which it digs with its Feet like a Rabbet, making a Neſt with Hay, or Straw, to lodge itſelf warm) it is very fat; [*Hildanus* took out above a Pound and a Half of Fat between the Skin and Muſcles, and a Pound out of the *Abdomen*] but, on the contrary, in the Spring-time when it comes forth again, very lean, as the Hunters experience in thoſe they then take. 3. The Internal Fat ſerves for the Defence and Security of the Veſſels, that they might lie ſoft, and be ſafely convey'd in their

Paſſage, wherefore it is eſpecially gathered about them.

By what Pores, or Paſſages, or Veſſels, the Fat is ſeparated from the Blood when it is redundant, and again abſorpt into it when it is deficient, is a Matter of curious Enquiry, and worthy to be induſtriouſly ſought out by the moſt ſagacious and dextrous Anatomiſts. The Veſſels whereinto it is received, and wherein contained, are by the Microſcope detected to be Bladders, and thoſe doubtleſs perforated and pervious one into another; and though for their exceſſive Subtlety and Thinneſs they appear not in a lean Body, yet ſeem to have been primitively formed and provided by Nature to receive the Fat upon Occaſion. Why the Fat is collected chiefly about ſome particular Parts and Veſſels, and not others; as for Example, the Reins and the Caul, I eaſily conſent with *Galen*, and others, the Reaſon to be the cheriſhing and keeping warm of thoſe Parts upon which ſuch Veſſels are ſpread; ſo the Caul ſerves for the warming the lower Belly, like an Apron, or Piece of Woollen Cloath. Hence a certain Gladiator, whoſe Caul *Galen* cut out, was ſo liable to ſuffer from the Cold, that he was conſtrained to keep his Belly conſtantly covered with Wool. For the Inteſtines containing a great deal of Food, thereto undergo its laſt Concoction, and no Veſſels of Blood penetrating it, and flowing through it to keep it warm, they had need be defended from the Injuries of the external Air, by outward Coverings. Why there ſhould be ſuch copious Fat gathered about the Reins to encloſe them, is not ſo eaſy to diſcern: But ſurely there is a great and conſtant Heat required there for the Separation of the Urine from the Blood; the conſtant Separation and Excretion whereof, is neceſſary for the Preſervation of Life. And we ſee, if the Blood be in any Degree chill'd, the Secretion of Urine is in a great Meaſure ſtopt, and the *Serum* caſt upon the Glandules of the Mouth and Throat. And if the Blood be extraordinarily heated by Exerciſe, or otherwiſe, it caſts off its *Serum* plentifully by Sweat, which may be effected by the ſwift Motion of the Blood through the Glandules of the Skin, where its plentiful Streams being ſtrengthen'd and conſtipated into a Liquor, force their Way through thoſe Emunctories, which at other Times tranſmit only inſenſible Vapors. Some ſuch Effect may be wrought upon the Blood, by the Heat of the Kidneys. Certain it is, that the Humours, excerned by Sweat and Urine, are near a-kin, if not the ſame; and therefore it is worthy the Conſideration, whether there might not be ſome Uſe made of Sweating in a Suppreſſion of Urine. But I digreſs too far.

I ſhall only add to this Particular, That becauſe the Deſign of Nature in collecting Fat in theſe Places, is for the forementioned Uſe; it hath, for the effecting thereof, fitted the Veſſels there with Pores, or Paſſages, proper for the Separation and Tranſmiſſion of it.

I ſhould now proceed to treat of the Generation and Formation of the *Fœtus* in the Womb, but that is a Subject too difficult for me to handle; the Body of Man, and other Animals, being formed in the dark Receſſes of the *Matrix*, or, as the *Pſalmiſt* phraſes it, *Pſal.* cxxxix. 14. *made in ſecret, and curiouſly wrought in the loweſt Parts of the Earth.* This Work is ſo admirable and unaccountable, that neither the Atheiſts, nor Mechanick Philoſophers, have attempted to declare the Manner and Proceſs of it; but have (as I noted before) very cautiouſly and prudently broke off their Syſtems of Natural Philoſophy here, and left this Point untouch'd; and thoſe Accounts which ſome of them have attempted to give of the Formation of a few of the Parts, are ſo exceſſively abſurd and ridiculous, that they need no other Confutation than *ha, ha, he.* And I have already farther ſhewn, that to me it ſeems impoſſible, that Matter divided into as minute and ſubtle Parts as you will, or can imagine, and thoſe moved according to what Catholick Laws ſoever can be deviſed, ſhould without the Preſidency and Direction of ſome intelligent Agent, by the meer Agitation of a gentle Heat, run itſelf into ſuch a curious Machine, as the Body of Man is.

Yet muſt it be confeſs'd, that the Seed of Animals is admirably qualified to be faſhioned and formed by the *Plaſtick Nature* into an Organical Body, containing the Principles, or component Particles of all the ſeveral homogeneous Parts thereof; for indeed every Part of the Body ſeems to club and contribute to the Seed, elſe why ſhould Parents that are born Blind, or Deaf, or that want a Finger, or any other Part, or have one ſuperfluous, ſometimes generate Children that have the ſame Defects, or Imperfections; and yet (which is wonderful) nothing of the Body, or groſſer Matter of the Seed, comes near the firſt Principle of the *Fœtus*, or in ſome ſo much as enters the Womb, but only ſome contagious Vapour, or ſubtle *Effluviums* thereof; which ſeems to animate the *Gemma*, or *Cicatricula* of the Egg contain'd in the Female *Ovary*, before it paſſes through the *Tubes*, or *Cornua*, into the *Uterus*. How far the Animalcules obſerv'd in the Seed of Males may contribute to Generation, I leave to the more ſegacious Philoſophers to enquire, and ſhall here content myſelf with referring the Reader to the ſeveral Letters publiſh'd by Mr. *Lewenhoek*.

But to what ſhall we attribute the *Fœtus* its Likeneſs to the Parents, or omitting them to the precedent Progenitors, as I have obſerv'd ſome Parents that have been both black Hair'd, to have generated moſt red Hair'd Children, becauſe their Anceſtor's Hair hath been of that Colour; or why are Twins ſo often extremely alike? Whether is this owing to the Efficient, or to the Matter?

Thoſe *Effluvia* we ſpake of in the Male Seed, as ſubtle as they are, yet have they a great, if not the greateſt Stroke in Generation, as is clearly demonſtrable in a Mule, which doth more reſemble the Male Parent, that is the Aſs, than the Female, or Horſe. But now, why ſuch different *Species* ſhould not only mingle together, but alſo generate an Animal, and yet that that hybridous Production ſhould not again generate, and ſo a new Race be carried on, but Nature ſhould ſtop here, and proceed no farther, is to me a Myſtery, and unaccountable.

One thing relating to Generation I cannot omit; that is, the Conſtruction of a Sett of Temporary Parts (like Scaffolds in a Building) to ſerve a preſent End, which are afterwards laid aſide, afford a ſtrong Argument of Council and Deſign. Now for the Uſe of the Young, during its Encloſure in the Womb, there are ſeveral Parts formed, as the Membranes inveloping it, called the *Secundines*, the Umbilical Veſſels, one Vein, and two Arteries; the *Urachus* to convey the Urine out of the Bladder, and the *Placenta Uterina*; Part whereof fall away at the Birth, as the *Secundines* and *Placenta*; others degenerate into Ligaments, as the *Urachus*, and Part of the Umbilical Vein: Beſides which, becauſe the *Fœtus*, during its Abode in the Womb, hath no Uſe of Reſpiration by the Lungs, the Blood doth not all, I may ſay not the greateſt Part of it, flow through them; but there are two Paſſages, or Chanels contrived, one called the *Foramen Ovale*, by which Part of the Blood brought by the *Vena Cava*, paſſeth immediately into the

Left Ventricle of the Heart, without entring the Right at all; the other is a large Arterial Chanel paſſing from the Pulmonary Artery immediately into the *Aorta*, or Great Artery, which likewiſe derives Part of the Blood thither, without running at all into the Lungs: Theſe two are cloſed up ſoon after the Child is born, when it breathes no more (as I may ſo ſay) by the *Placenta Uterina*, but Reſpiration by the Lungs is needful for it. It is here to be noted, that though the Lungs be formed ſo ſoon as the other Parts, yet during the Abode of the *Fœtus* in the Womb, they lie by as uſeleſs. In like manner I have obſerved, that in ruminating Creatures, the three foremoſt Stomachs, not only during the Continuance of the Young in the Womb, but ſo long as it is fed with Milk, are unemployed and uſeleſs, the Milk paſſing immediately into the fourth.

Another Obſervation I ſhall add concerning Generation, which is of ſome Moment, becauſe it takes away ſome Conceſſions of Naturaliſts, that give countenance to the Atheiſts fictitious and ridiculous Account of the firſt Production of Mankind, and other Animals, *viz.* That all ſorts of Inſects, yea, and ſome Quadrupeds too, as Frogs and Mice, are produced ſpontaneouſly. My Obſervation and Affirmation is, that there is no ſuch thing in Nature, as Æquivocal or Spontaneous Generation, but that all Animals, as well ſmall as great, not excluding the vileſt and moſt contemptible Inſect, are generated by Animal Parents of the ſame *Species* with themſelves; that Noble *Italian* Vertuoſo, *Franciſco Redi*, having experimented, that no putrified Fleſh (which one would think were the moſt likely of any thing) will of itſelf, if all Inſects be carefully kept from it, produce any: The ſame Experiment, I remember, Dr. *Wilkins*, late Biſhop of *Cheſter*, told me, had been made by ſome of the *Royal Society*. No Inſtance againſt this Opinion doth ſo much puzzle me, as Worms bred in the Inteſtines of Man, and other Animals. But ſeeing the round Worms do manifeſtly generate, and probably the other Kinds too, it's likely they come originally from Seed, which how it was brought into the Guts, may afterwards poſſibly be diſcovered. Moreover, I am inclinable to believe, that all Plants too, that themſelves produce Seed, (which are all but ſome very imperfect ones, which ſcarce deſerve the Name of Plants) come of Seeds themſelves. For that great Naturaliſt *Malpighius*, to make Experiment whether Earth would of itſelf put forth Plants, took ſome purpoſely digged out of a deep Place, and put it into a Glaſs-Veſſel, the Top whereof he covered with Silk many times doubled, and ſtrained over it, which would admit the Water and Air to paſs through, but exclude the leaſt Seed that might be wafted by the Wind; the Event was, that no Plant at all ſprang up in it. Nor need we wonder, how in a Ditch, Bank, or Graſs-Plat, newly digg'd, or in the Fen-Banks, in the Iſle of *Ely*, Muſtard ſhould abundantly ſpring up, where, in the Memory of Man, none hath been known to grow; for it might come of Seed which had lain there more than a Man's Age. Some of the Ancients mentioning ſome Seeds that retain their Fecundity forty Years. And I have found in a Paper received from a Friend, but whom I have forgotten, That Melon-Seeds, after thirty Years, are beſt for raiſing of Melons. As for the Muſtard that ſprung up in the Iſle of *Ely*, though there had never been any in that Country, yet might it have been brought down in the Chanels by the Floods, and ſo being thrown up the Banks, together with the Earth, might germinate and grow there.

And, indeed, a ſpontaneous Generation of Animals and Plants, upon due Examination, will be found to be nothing leſs than a Creation of them. For after the Matter was made, and the Sea and dry Land ſeparated, how is the Creation of Plants and Animals deſcribed but by a commanding, that is, effectually cauſing the Waters and Earth to produce their ſeveral Kinds without any Seed? Now Creation being the Work of Omnipotency, and incommunicable to any Creature, it muſt be beyond the Power of Nature, or natural Agents, to produce Things after that manner. And as for God Almighty, He is ſaid to have reſted from His Work of Creation after the Seventh Day. But, if there be any ſpontaneous Generation, there was nothing done at the Creation, but what is daily done; for the Earth and Water produc'd Animals then without Seed, and ſo they do ſtill.

Becauſe ſome, I underſtand, have been offended at my confident Denial of all ſpontaneous Generation, accounting it too bold and groundleſs, I ſhall a little enlarge upon it, and give my Reaſons, in order to their Satiſfaction.

Firſt, Then, I ſay, ſuch a ſpontaneous Generation ſeems to me to be nothing leſs than a Creation. For, Creation being not only a Production of a Thing out of Nothing, but alſo out of indiſpoſed Matter, as may be clearly inferred from the Scripture, and is agreed by all Divines; this ſpontaneous Generation, being ſuch a Production, wherein doth it differ from Creation? Or, what did God Almighty do at the firſt Creation of Animals and Plants, more than what (if this be true) we ſee every Day done? To me, I muſt confeſs, it ſeems almoſt demonſtrable, that whatever Agent can introduce a Form into indiſpoſed Matter, or diſpoſe the Matter in an inſtant, muſt be ſuperior to any Natural one, not to ſay Omnipotent.

Secondly, Thoſe who have with the greateſt Diligence and Application conſidered and ſearched into this Matter, as thoſe eminent Virtuoſi, *Marcellus Malpighius*, *Franciſcus Redi*, *John Swammerdam*, *Lewenhoek*, and many others, are unanimouſly of this Opinion, ſave that *Franc. Redi* would except ſuch Inſects as are bred in Galls, and ſome other Excreſcencies of Plants. Now their Authority weighs more with me, than the general Vogue, or the concurrent Suffrages of a thouſand others, who never examined the Thing ſo carefully and circumſpectly as they have done, but run away with the Cry of the common Herd of Philoſophers.

Firſt of all, Dr. *Swammerdam*, who hath been, to the beſt Purpoſe of any Man I know of, buſied in ſearching out and obſerving the Nature of all Inſects in general; all in general I ſay, for as to one particular Inſect, to wit, the Silk-Worm, I muſt except Signior *Malpighy*; and to one *Genus* of them, to wit, Spiders, Dr. *Liſter*, in his general Hiſtory of Inſects, written in *Low Dutch*, and tranſlated into *French*, *p*. 47. hath theſe Words, *Nous diſons, qu'il ne ſe fait dans toute la nature aucune generation par accident*, &c. *We affirm, that there is not in all Nature any accidental* [*or ſpontaneous*] *Generation, but all come by Propagation; wherein Chance hath not the leaſt Part, or Intereſt.* And in *p*. 159. ſpeaking of the Generation of Inſects out of Plants, in Contradiction I ſuppoſe to Seignior *Redi*, he ſaith, *Nous croyons abſolument*, &c. *We do abſolutely believe, that it is not poſſible to prove by Experience, that any Inſects are engendred out of Plants: But, on the contrary, we are very well informed and aſſured, that theſe little Animals are not ſhut up in, or encloſed there for any other Reaſon than to draw thence their Nouriſhment.* It's true indeed, that by a certain, conſtant, and immutable Order of Nature, we ſee many ſorts of Inſects affixed to particular *Species* of Plants and Fruits, to which the reſpective Kinds faſten themſelves as it were by Inſtinct. But we are to know, that they all come of the Seed of Animalcules of their own Kind, that were before laid there. For theſe Inſects do thruſt their Seed, or Eggs, ſo deep into the Plants, that they come to be afterwards as it were united with them, and the Aperture, or Orifice, by which they entred, quite cloſed up, and obliterated; the Eggs being hatched and nouriſhed within. We have often found the Eggs of Inſects ſo deeply ſunk into the tender Buds of Trees, that without hurting of them it was impoſſible to draw them out. Many Inſtances he produces in ſeveral ſorts of Inſects making their way into Plants, which, though they be well worth the reading, are too long to tranſcribe.

Secondly, That Great and Sagacious Naturaliſt, and moſt Accurate Examiner of theſe Things, Signior *Malpighy*, in his Treatiſe of *Galls*, under which Name he comprehends all Preternatural and Morboſe Tumors and Excreſcencies of Plants, doth demonſtrate in particular, that all ſuch Warts, Tumors, and Excreſcencies, where any Inſects are found, are excited, or raiſed up, either by ſome Venenoſe Liquor, which, together with their Eggs, ſuch Inſects ſhed upon the Leaves, or Buds, or Fruits of Plants, or boring with their *Terebræ*, inſtil into the very Pulp of ſuch Buds, or Fruits; or by the contagious Vapor of the very Eggs themſelves producing a Mortification, or Syderation in the Parts of Plants on which they are laid; or laſtly, by the Grubs, or Maggots, hatch'd of the Eggs laid there, making their way with their Teeth into the Buds, Leaves, or Fruit, or even the Wood itſelf, of ſuch Plants on which their Eggs were laid. So at laſt he concludes, *Erunt itaque Gallæ & reliqui plantarum tumores morboſæ excreſcentiæ, vi depoſiti ovi à turbata plantarum compage, & vitiato humorum motu excitatæ, quibus incluſa ova & animalcula velut in utero foventur & augentur, donec manifeſtatis firmatiſque propriis partibus, quaſi exoriantur novam exoptantia auram. We conclude therefore, that Galls, and other Tumors of Plants, are nothing elſe but morboſe Excreſcencies, raiſed up by the Force of the Eggs there laid, diſturbing the Vegetation and Temper of the Plants, and perverting the Motion of their Humours and Juices; wherein the encloſed Eggs and Animalcules are cheriſhed, nouriſhed, and augmented, till their proper Parts being manifeſted, explicated, and hardned, or ſtrengthned, they are as it were new-born, affecting to come forth into the open Air.* In the ſame Treatiſe he deſcribes the hollow Inſtrument, (*Terebra* he calls it, and we may *Engliſh* it *Piercer*) wherewith many Flies are provided, proceeding from the Womb, with which they perforate the Teguments of Leaves, Fruits, or Buds, and through the Hollow of it inject their Eggs into the Holes, or Wounds which they have made, where, in Proceſs of Time, they are hatch'd and nouriſh'd.

This he beheld one of theſe Inſects doing, with his own Eyes, in the Bud of an Oak; the manner whereof he deſcribes, *p.* 47. which I ſhall not tranſcribe, only take Notice, that when he had taken off the Inſect, he found in the Leaf very Little and Diaphanous Eggs, exactly like to thoſe which yet remained in the Tubes of the Fly's Womb. He adds farther, that it is probable that there may be Eggs hidden in divers Parts of Plants whereof no Footſtep doth outwardly appear, but the Plant remains as entire, and thrives as well as if there were no Inſect there: Nay, that ſome may be hidden and cheriſhed in dry Places, (not wanting any Humour to feed them) as in Sear-Wood, yea, in Earthen-Veſſels, and Marbles themſelves.

Indeed to me it ſeems unreaſonable, that Plants being of a lower Form or Order of Being ſhould produce Animals; for either they muſt do it out of indiſpoſed Matter, and then ſuch Production would amount to a Creation, or elſe they muſt prepare a fit Matter, which is to act beyond their Strength, there being required to the Preparation of the Sperm of Animals a great *Apparatus* of Veſſels, and many Secretions, Concoctions, Reflections, Digeſtions, and Circulations of the Matter, before it can be rectified and exalted into ſo noble a Liquor: And beſides, there muſt be an Egg too; for we know *ex ovo omnia*; to the Perfection whereof, there are as many Veſſels, and as long a Proceſs required. Now in Plants there are no ſuch Veſſels, and conſequently no ſuch Preparation of Eggs or Sperm, which are the neceſſary Principles of Animals.

Thirdly, That worthy Author of our own Country, I mean Dr. *Liſter*, in his notes upon *Geodartius Inſect. Numb.* 16. *p.* 47. hath theſe Words: *Non enim inducor ut credam, hoc, vel aliud quodvis Animal, modo quodam ſpontaneo è Planta produci, & alii cauſæ cuicunque originem ſuam debere quàm Parenti Animali*; i. e. *I cannot be perſuaded or induced to believe, that this or any other Animal is (or can be) produced out of a Plant in a ſpontaneous Manner, or doth owe its Original to any other Cauſe whatever, than an Animal Parent of its own Kind.* And in his third Note upon *Inſect. Numb.* 49. theſe: *Quoad ſpontaneam Erucæ hujus aliorûmque Inſectorum generationem, pro parte negativa jam ſententiam meam tradidi*, &c. *As to the Spontaneous Generation of this* Eruca, *and other Inſects, I have already delivered my Opinion for the Negative. This is moſt certain, that theſe* Coſſi *are produced of Eggs laid by Animal Parents: It is alſo alike clear, that theſe diminutive Caterpillars are able by Degrees to pierce or bore their way into a Tree; which very ſmall Holes, after they are fully entred, do perchance grow together, and quite diſappear; at leaſt become ſo ſmall, that they are not to be diſcerned, unleſs by* Lynceus's *Eyes. Add moreover, that perchance they undergo no Transformation, but continue under the Vizzard of* [Erucæ] *Caterpillars for many Years, which doth very well accord with my Obſervations. Moreover, that this Caterpillar* [Eruca] *is propagated*

gated by Animal Parents, to wit, Butterflies, after the common Origination of all Caterpillars. In all this I fully conſent with the Doctor; only crave leave to differ in his attributing to them the Name of *Coſſi*, which were accounted by the Ancients of a delicate Morſel, and fed for the Table; for I take thoſe to have been the Hexapods, from which the greater ſort of Beetles come; for that that ſort of Hexapods are at this Day eaten in our *American* Plantations, as I am informed by my good Friend Dr. *Hans Sloane*; who alſo preſented me with a Glaſs of them, preſerved in Spirit of Wine.

Having lately had an Opportunity more curiouſly to view and examine the great fleſh-colour'd, thin-hair'd *Engliſh* Caterpillar, (which is ſo like that ſent me by Dr. *Sloane*, that it differs little but in Magnitude, which may be owing to the Climate,) I obſerved that it had a Power of drawing its eight hind Legs or Stumps ſo far up in its Body, that they did altogether diſappear, ſo that the Creature ſeemed to want them, and of thruſting them out again at Pleaſure: Whereupon I conjectured, That that Inſect of *Jamaica* ſent me by the Doctor, (which I took to be the *Coſſus* or *Hexapod*, previous to ſome large Beetle) had likewiſe the ſame Power of drawing up its hind Legs; ſo that though to Appearance it wanted them, yet really it did not ſo, but had only drawn them up, and hid them in its Body, when it was immerſed in the Spirit of Wine, and conſequently was not the *Hexapod* of a Beetle, but an

Eruca, like to, or indeed ſpecifically the ſame with that of our own Country by me obſerved; and being eaten at this Day by the Inhabitants of *Jamaica*, is in all likelihood the ſame with the *Coſſus* of the ancient *Romans*, which was fed for the Table, as *Pliny* aſſures us: Eſpecially, if we conſider, that Dr. *Liſter* found this *Eruca* in the Body of an Oak newly cut down, and ſawed in Pieces; on which Tree, *Pliny* ſaith, they feed. Thus much I thought fit to add to Dr. *Liſter*, and do the Truth right, by retracting my former Conjecture concerning the *Coſſi*.

3. My third Argument againſt Spontaneous Generation, is, becauſe there are no Arguments or Experiments, which the Patrons of it do or can produce, which do clearly evince it. For the general and vulgar Opinion, that the Heads of Children, or the Bodies of thoſe that do not change their Linen, but wear that which is ſweaty and ſordid, breeds Lice; or that Cheeſe of itſelf breeds Mites or Maggots; I deny, and look upon it as a great Error and Miſtake; and do affirm, that all ſuch Creatures are bred of Eggs laid in ſuch ſordid Places by ſome wandring Louſe or Mite, or Maggot. For ſuch Places being moſt proper for the Hatching and Excluſion of their Eggs, and for the Maintenance of their Young, Nature hath endued them with a wonderful Acuteneſs of Scent and Sagacity, whereby they can, though far diſtand, find out, and make towards them. And even Lice and Mites themſelves, as ſlow as

they ſeem to be, can, to my knowledge, in no long time march a conſiderable way to find out a convenient Harbour for themſelves.

Here, by the by, I cannot but look upon the ſtrange Inſtinct of this noiſome and troubleſome Creature a Louſe, of Searching out foul and naſty Clothes to harbour and breed in, as an Effect of Divine Providence, deſigned to deter Men and Women from Sluttiſhneſs and Sordidneſs, and to provoke them to Cleanlineſs and Neatneſs. God himſelf hateth Uncleanlineſs, and turns away from it, as appears by *Deut.* cap. xxiii. ver. 12, 13, 14. But if God requires, and is pleaſed with bodily Cleanlineſs, much more is he ſo with the Pureneſs of the Mind. *Bleſſed are the pure in Heart, for they ſhall ſee God,* Matth. v. 10.

As for the Generation of Inſects out of putrid Matter, the Experiments of *Franciſcus Redi*, and ſome of our own *Virtuoſi*, give me ſufficient Reaſon to reject it. I did but juſt now mention the quick Scent that Inſects have, and the great Sagacity in finding out a proper and convenient Harbour or *Matrix*, to cheriſh and hatch their Eggs, and feed their Young: They are ſo acted and directed by Nature, as to caſt their Eggs in ſuch Places as are moſt accommodate for the Excluſion of their Young, and where there is Food ready for them as ſoon as they be hatch'd: Nay, it is a very hard matter to keep off ſuch Inſects from ſhedding their Seed in ſuch proper Places. *Indeed, if an Inſect may be thus equivocally generated, why not* *ſometimes a Bird? A Quadruped, a Man, or even an Univerſe? Or, why no new Species of Animal now and then?* As my Learned Friend Dr. *Tancred Robinſon* very well argues in his Letters: *For there is as much Art ſhewn in the Formation of thoſe, as of theſe.*

A fourth and moſt effectual Argument againſt Spontaneous Generation, is, that there are no new Species produced, which would certainly now and then, nay, very often happen, were there any ſuch thing. For in ſuch pretended Generations, the Generant or Active Principle is ſuppoſed to be the Sun, which being an inanimate Body, cannot act otherwiſe than by his Heat; which Heat can only put the Particles of the paſſive Principle into Motion. The paſſive Principle is putrid Matter; the Particles whereof cannot be conceived to differ in any thing but Figure, Magnitude, and Gravity. Now the Heat putting theſe Particles in Motion, may indeed gather together thoſe which are homogeneous, or of the ſame Nature, and ſeparate thoſe that are heterogeneous, or of a different; but that it ſhould ſo ſituate, place, and connect them, as we ſee in the Bodies of Animals, is altogether inconceivable; which, if it could, yet that it ſhould always run them into ſuch a Machine as is already extant, and not often into ſome new faſhioned one, ſuch as was never ſeen before, no Reaſon can be aſſigned or imagined. This the *Epicurean* Poet *Lucretius* was ſo ſenſible of, that he ſaw a Neceſſity of granting Seeds or Principles to determine the Species. For (*ſaith he*) if all ſorts of Principles could be connected,

——Vulgò fieri portenta videres,
Semiferas hominum ſpecies exiſtere, & altos
Interdum ramos egigni corpore vivo;
Multáque connecti terreſtria membra marinis;
Tum flammam retro ſpirantes ore chimæras
Paſcere naturam per terras omniparenteis
Quorum nil fieri manifeſtum eſt, omnia quando
Seminibus certis, certa genetrice, creata
Conſervare genus creſcentia poſſe videmus, &c.

That is, ——*Thence would riſe*
Vaſt Monſters, Nature's great Abſurdities;
Some thing half Beaſt, half Man, and ſome would grow
Tall Trees above, and Animals below,
Some join'd of Fiſh, and Beaſts, and every where
Frightful Chimæra's *breathing Flames appear.*
But ſince we ſee no ſuch, and things ariſe
From certain Seeds of certain Shape and Size,
And keep their Kind as they increaſe and grow,
There's ſome fixt Reaſon why it ſhould be ſo.

The raining of Frogs, and their Generation in the Clouds, though it be atteſted by many and great Authors, I look upon as utterly falſe and ridiculous. It ſeems to me no more likely, that Frogs ſhould be ingender'd in the Clouds, than *Spaniſh* Gennets begotten by the Wind; for that hath good Authors too. And he that can ſwallow the raining of Frogs, hath made a fair Step towards believing, that it may rain Calves alſo; for we read that one fell out of the Clouds in *Avicen*'s Time. Nor do they much help the matter, who ſay, that thoſe Frogs that appear ſometimes in great multitudes after a Shower, are not indeed engendred in the Clouds, but coagulated of a certain ſort of Duſt, commixt and fermented with Rain-water; to which *Hypotheſis Fromondus* adheres.

But let us a little conſider the Generation of Frogs in a natural Way. 1. There are two different Sexes, which muſt concur to their Generation. 2. There is in both a great *Apparatus* of Spermatick Veſſels, wherein the nobler and more ſpirituous Part of the Blood, is by many Digeſtions, Concoctions, Reflections, and Circulations, exalted into that generous Liquor we call Sperm; and likewiſe for the preparing of the Eggs. 3. There muſt be a Copulation of the Sexes; which I rather mention, becauſe it is the moſt remarkable in this, that ever I obſerved in any Animal. For they continue in *Complexu Venereo* at leaſt a Month indefinitely; the Male all that while reſting on the Back of the Female, clipping and embracing her with his Legs about the Neck and Body, and holding her ſo faſt, that if you take him out of the Water, he will rather bear her whole Weight, than let her go. This I obſerved in a couple, kept on purpoſe in a Veſſel of Water, by my Learned and Worthy Friend Mr. *John Nid*, Fellow of *Trinity* College, long ſince deceaſed. After this, the Spawn muſt be caſt into Water, where the Eggs lie in the midſt of a copious Jelly, which ſerves them for their firſt Nouriſhment for a conſiderable while. And at laſt, the Reſult of all is not a perfect Frog, but a Tadpole without any Feet, and having a long Tail to ſwim withal; in which Form it continues a long time, till the Limbs be grown out, and the Tail fallen away, before it arrives at the Perfection of a Frog.

Now, if Frogs can be generated ſpontaneouſly in the Clouds out of Vapour, or upon the Earth out of Duſt and Rain-Water, what needs all this a-do? To what purpoſe is there ſuch an *Apparatus* of Veſſels for the Elaboration of the Sperm and Eggs; ſuch a tedious Proceſs of Generation and Nutrition? This is but an idle Pomp. The Sun (for he is ſuppoſed to be the equivocal Generant or Efficient by theſe Philoſophers) could have diſpatch'd the Buſineſs in a trice: Give him but a little Vapour, or a little dry duſt and Rain-Water, he will produce you a quick Frog, nay, a whole Army of them, perfectly form'd, and fit for all the Functions of Life in three Minutes, nay, in the hundredth Part of one Minute, elſe muſt ſome of thoſe Frogs that were generated in the Clouds fall down half-formed and imperfect, which I never heard they did; and the Proceſs of Generation have been obſerved in the Production of Frogs out of Duſt and Rain-Water, which no Man ever pretended to mark or diſcern. But that there can be no Frogs generated in the Clouds, may further be made appear, 1. From the extreme Cold of the middle Region of the Air, where the Vapours are turned into Clouds, which is not at all propitious to Generation. For did not ſo great Men as *Ariſtotle* and *Eraſmus* report it, I could hardly be induced to believe that there could be one *Species* of Inſects generated in Snow. 2. Becauſe, if there were any Animals engender'd in the Clouds, they muſt needs be maimed and daſhed in Pieces by the fall, at leaſt ſuch as fell in the High-ways, and upon the Roofs of Houſes; whereas we read not of any ſuch broken or imperfect Frogs found any where. This laſt Argument was ſufficient to drive off the Learned *Fromondus* from the Belief of their Generation in the Clouds; but the Matter of Fact he takes for granted, I mean the Spontaneous Generation of Frogs out of Duſt and Rain-Water, from an Obſervation or Experiment of his own at the Gates of *Tournay* in *Flanders*, to the Sight of which Spectacle, he called his Friends who were there preſent, that they might admire it with him. *A ſudden Shower* (ſaith he) *falling upon the very dry Duſt, there ſuddenly appeared ſuch an Army of little Frogs, leaping about every where upon the dry Land, that there was almoſt nothing elſe to be ſeen. They were alſo of one Magnitude and Colour; neither did it appear out of what lurking Places* [Latibula] *ſo many Myriads could creep out, and ſuddenly diſcover themſelves upon the dry and duſty Soil, which they hate.* But ſaving the Reverence due to ſo great a Man, I doubt not but they did all creep out of their Holes and Coverts, invited by the agreable Vapour of the Rain-Water. This, however unlikely it may ſeem, is a thouſand Times more probable than their inſtantaneous and undiſcernible Generation out of a little dry Duſt and Rain-Water, which alſo cannot have any time to mix and ferment together, which is the *Hypotheſis* he adheres to. Nay, I affirm, that it is not at all improbable; for he that ſhall walk out in Summer-Nights, when it begins to grow dark, may obſerve ſuch a Multitude of great Toads and Frogs crawling about in the High-ways, Paths and Avenues to Houſes, Yards and Walks of Gardens and Orchards, that he will wonder whence they came, or where they lurk'd all the Winter, and all the Day-time, for that then it's a rare thing to find one.

To which add, That in ſuch Frogs as we are ſpeaking of, Monſieur *Perault* hath, upon Diſſection, often found the Stomach full of Meat, and the Inteſtines of Excrement; whence he juſtly concludes, 'That they were not then 'firſt formed, but only appeared of a ſudden; 'which is no great wonder, ſince upon a Shower, 'after a Drought, Earth-Worms and Land-Snails 'innumerable come out of their lurking Places 'in like manner.

In Confirmation of what I have here written againſt the Spontaneous Generation of Frogs, either in the Clouds out of Vapour, or on the Earth out of Duſt and Rain-Water commix'd, endeavouring to prove, by Force of Argument, that there is no ſuch thing, I have lately received from my Learned and Ingenious Friend Mr. *William Derham*, Rector of *Upminſter*, near *Rumford* in *Eſſex*, a Relation parallel to that of *Fromondus*, concerning the ſudden Appearance of a vaſt Number of Frogs after a Shower or two of Rain marching croſs a ſandy way, that before the Rain was very duſty; and giving an Account, where, in all Likelihood, they were generated by Animal Parents of their own Kind, and whence they did proceed. The whole Narrative I ſhall give the Reader in his own Words.

Some Years ago, as I was riding forth one Afternoon in Berks, *I happened upon a prodigious Multitude creeping croſs the way. It was a ſandy Soil, and the Way had been full of Duſt, by Reaſon of a dry Seaſon that then was. But an Hour or two before, a refreſhing fragrant Shower or two of Rain had laid the Duſt. Whereupon, what I had heard or read of the Raining of Frogs immediately came to my Thoughts, as it eaſily might do, there being probably as good Reaſon then for me, as I believe any ever had before, to conclude, that theſe came from the Clouds, or were inſtantaneouſly generated. But being prepoſſeſſed with the contrary Opinion,* viz. *that there was no equivocal Generation, I was very curious in enquiring whence this vaſt Colony might probably come: And upon ſearching, I found two or three Acres of Land* *cover'd with this black Regiment, and that they all marched the ſame Way towards ſome Woods, Ditches, and ſuch like cool Places in their Front, and from large Ponds in their Rear. I traced them backwards, even to the very Side of one of the Ponds. Theſe Ponds in ſpawning Time always uſed to abound much with Frogs, whoſe Croaking I have heard at a conſiderable Diſtance; and a great deal of Spawn I have found there.*

From theſe Circumſtances I concluded, that this vaſt Colony was bred in thoſe Ponds from whenceward they Steered their Courſe: That after their Incubation (if I may ſo call it) or Hatching by the Sun, and their having paſs'd their Tadpole-State, they had lived (till that time of their Migration) in the Waters, or rather on the Shore, among the Flags, Ruſhes, and long Graſs: But now being invited out by the refreſhing Showers, then newly fallen, which made the Earth cool and moiſt for their March, that they left their old Latibula, *where perhaps they had devoured all their proper Food, and were now in Purſuit of Food, or a more convenient Habitation.*

This I think not only reaſonable to be concluded, but withal ſo eaſy to have been diſcovered by any inquiſitive Obſerver, who in former Times met with the like Appearance, that I cannot but admire that ſuch ſagacious Philoſophers, as Ariſtotle, Pliny, *and many other ſince, ſhould ever imagine Frogs to fall from the Clouds, or be any way inſtantaneouſly or ſpontaneouſly generated; eſpecially*

eſpecially conſidering how openly they act their Coition, produce Spawn, this Spawn Tadpoles, and Tadpoles Frogs.

Neither in Frogs only, but alſo in many other Creatures, as Lice, Fleſh-Flies, Silk-Worms, and other Papilio's, *an uniform regular Generation was very obvious, which is an Argument to me of a ſtrange Pre-poſſeſſion of Fancy in the Ages ſince* Ariſtotle, *not to ſay of Careleſneſs and Sloth.* So far Mr. *Derham.*

In like manner, doubtleſs, *Fromondus*, had he made a diligent ſearch, might have found out the Place where thoſe Myriads of Frogs, obſerved by him about the Gates of *Tournay*, were generated, and whence they did proceed.

As for the Worms and other Animals bred in the Inteſtines of Man and Beaſt, I have declared my ſelf not to be ſatisfied of the Ways and Means how their Seeds come to be conveyed into thoſe Places; but yet, that their Generation is Analogous to that of other Creatures of thoſe Kinds, I doubt not. The Conſtancy to their *Species*, their exact Agreement and perpetual Similitude in the Shape and Figure of their Bodies, and all their Parts, their Conſiſtence, Temper, Motion, and other Accidents, are to me little leſs than a Demonſtration, that they are not the Effects of Chance, but the Products of a ſettled and ſpermatick Principle. I am at preſent, 'till better informed, of Opinion, that their Eggs are ſwallowed with the Meat we eat; and I am the rather induced to think ſo, becauſe Children in their firſt Infancy, and as long as they are conſtantly confined to a Milk-Diet, are ſeldom troubled with them.

After this was written, I received a Letter from my often remembred ingenious Friend Dr. *Tancred Robinſon*, referring to this Matter; part whereof I ſhall tranſcribe, as being very pertinent, inſtructive and conſonant to my own Thoughts: *I think it may be proved, that the vaſt Variety of Worms found in almoſt all the Parts of different Animals, as well* Terreſtrial *as* Aquatick, *are taken into their reſpective Bodies by Meats and Drinks, and there either lie ſtill for ſome time, or elſe grow and alter by Change of Place and Food, [not ſpecifically, but accidentally, in Magnitude, Colour, Figure of ſome Parts, or the like.] We know as yet but little of the numerous* Inſects *bred in Water, or indeed of thoſe in Roots, Leaves, Buds, Flowers, Fruits, and Seeds, which we are continually ſwallowing; and theſe too all vary according to Climate; [That is, the ſame Species of* Roots, Leaves, *&c. do in different Climates produce many different Species of Inſects, tho' ſome there be common to all;] The long ſlender Worms, as ſmall as Hairs, that breed between the Skin and the Fleſh in the Iſle of* Ormuz, *and in* India, *which are generally twiſted out upon Sticks or Rowlers, and often break in the Operation, are without doubt taken in by the Water they drink in thoſe Regions, as I could prove by many and good Experiments, had I time. They* *who have Leiſure, may find them in the Collections of Voyages and Travels, eſpecially in Monſieur* Thevenot. *By this Explication we may give a better Account of the Vomitings up of Tadpoles, Snails, and other Animals, recorded in Medical Hiſtories, than by any Hypotheſis of Equivocal Generation. As to Inſects found in ſtinking Fleſh, or rotten Vegetables, I could never obſerve or find any of them different from thoſe Parent Inſects, which hover about, or feed upon ſuch Bodies.*

If any ſhall object the infinite Multitudes of Animalcules diſcovered in Pepper-Water, and deſire an Account of their Generation; to him, I ſhall ſay, that it is probable, that ſome few of theſe Animals may be floating in all Waters, and that finding the Particles of Pepper ſwimming in the Water, very proper for the cheriſhing and excluding of their Eggs, by reaſon of their Heat, or ſome other unknown and ſpecifick Quality, they may faſten their Eggs to them, and ſo there may be a ſudden Breed of infinite Swarms of them. But theſe being not to be diſcerned by the moſt piercing and *Lyncean* Sight, without the Aſſiſtance of a Microſcope, I leave the Manner of their Generation to future Diſcovery.

No leſs difficult is it to give an Account of the Original of ſuch Inſects as are found and ſeem to be bred in the Bodies of others of different Kinds. Out of the Sides and Back of the moſt common Caterpillar, which feeds upon Cabbage, Cole-wort, and Turnep-

Leaves, which we have deſcribed in the Catalogue of *Cambridge-Plants*, we have ſeen creep out ſmall Maggots, to the Number ſometimes of Threeſcore, or more; which ſo ſoon as ever they came forth, began to weave themſelves ſilken Caſes of a yellow ſhining Colour, wherein they changed, and, after ſome Time, came out thence in the Form of ſmall Flies with four Wings; for a full Deſcription and Hiſtory whereof, I ſhall refer the Reader to the forementioned Catalogue. The like I have alſo obſerved in other Caterpillars of a different Kind, which have produced no leſſer Number of Maggots, that in like manner immediately made themſelves up in Caſes. Others, inſtead of changing into *Aurelia's*, as in the uſual Proceſs of Nature they ought to do, have turned into one, two, three, or more Fleſh-Fly Caſes, at leaſt contained ſuch Caſes within them, out of which, after a while, were excluded Fleſh-Flies. Other Caterpillars, as that called the *Solitary Maggot*, found in the dry Heads of Teaſel, by a dubious *Metamorphoſis*, ſometimes changed into the *Aurelia* of a Butterfly, ſometimes into a Fly-Caſe. You'll ſay, How comes this to paſs? Muſt we not here neceſſarily have recourſe to a ſpontaneous Generation? I anſwer, No: The moſt that can be inferred from hence is, a Tranſmutation of *Species*; one Inſect may, inſtead of generating another of its own Kind, beget one or more of a different. But I can by no means grant this. I do believe, That theſe Flies do either caſt their Eggs upon the very Bodies of the forementioned Caterpillars, or upon the Leaves on which they feed, all in a String; which there hatching, eat their Way into the Body, where they are nouriſhed till they be come to their full Growth. Or it may be, the Fly may with the hollow and ſharp Tube of her Womb punch and perforate the very Skin of the *Eruca*, and caſt her Eggs into its Body: So the *Ichneumon* will convey her Eggs into Caterpillars.

The Diſcovery of the Manner of the Generation of theſe Sorts of Inſects I earneſtly recommend to all ingenious Naturaliſts, as a Matter of great Moment. For if this Point be but cleared, and it be demonſtrated that all Creatures are generated univocally by Parents of their own Kind, and that there is no ſuch Thing as Spontaneous Generation in the World, one main Prop and Support of Atheiſm is taken away, and their ſtrongeſt Hold demoliſhed: They cannot then exemplify their fooliſh *Hypotheſis* of the Generation of Man, and other Animals, at firſt, by the Like of Frogs and Inſects at this preſent Day.

It will be farther objected, That there have live Toads been found in the midſt of Timber-Trees; nay, of Stones, when they have been ſawn aſunder.

To this I anſwer, That I am not fully ſatiſfied of the Matter of Fact. I am ſo well acquainted with the Credulity of the Vulgar, and the Delight they, and many of the better

Sort too, have in telling of Wonders, and ſtrange Things, that I muſt have a Thing well atteſted, before I can give a firm Aſſent to it.

Since the Writing hereof, the Truth of theſe Relations of live Toads found in the midſt of Stones, hath been confirmed to me by ſufficient and credible Eye-witneſſes, who have ſeen them taken out; ſo that there is no doubt of the Matter of Fact.

But yet, ſuppoſe it be true, it may be accounted for. Thoſe Animals, when young and little, finding in the Stone ſome ſmall Hole reaching to the Middle of it, might, as their Nature is, creep into it, as a fit *Latibulum* for the Winter, and grow there too big to return back by the Paſſage by which they enter'd, and ſo continue impriſoned therein for many Years; a little Air, by reaſon of the Coldneſs of the Creature, and its lying torpid there, ſufficing it for Reſpiration, and the Humour of the Stone, by reaſon it lay immoveable, and ſpent not, for Nouriſhment. And I do believe, that if thoſe who found ſuch Toads, had diligently ſearched, they might have diſcovered and traced the Way whereby they enter'd in, or ſome Footſteps of it. Or elſe there might fall down into the lapideous Matter before it was concrete into a Stone ſome ſmall Toad, (or ſome Toad Spawn) which being not able to extricate itſelf and get out again, might remain there impriſoned till the Matter about it were condenſed and compacted into a Stone. But however it came there, I dare confidently affirm, it was not there ſpontaneouſly generated. For elſe, either there was ſuch a Cavity in the Stone before the Toad was generated; which is altogether improbable, and *Gratis Dictum*, aſſerted without any Ground; or, the Toad was generated in the ſolid Stone, which is more unlikely than the other, in that the ſoft Body of ſo ſmall a Creature ſhould extend itſelf in ſuch a Priſon, and overcome the Strength and Reſiſtance of ſuch a great and ponderous Maſs of ſolid Stone.

And whereas the Aſſertors of Equivocal Generation were wont to pretend the Imperfection of theſe Animals, as a Ground to facilitate the Belief of their Spontaneous Generation; I do affirm, That they are as perfect in their Kind, and as much Art ſhewn in the Formation of them, as of the greateſt; nay, more too, in the Judgment of that great Wit and Natural Hiſtorian * *Pliny*. *In magnis ſiquidem corporibus*, (ſaith he) *aut certè majoribus facilis officina ſequaci materia fuit; in his tam parvis atque tam nullis, quæ ratio, quanta vis, quam inextricabilis perfectio?* In the greater Bodies the Forge was eaſy, the Matter being ductile and ſequacious, obedient to the Hand and Stroke of the Artificer, apt to be drawn, formed, or moulded into ſuch Shapes and Machines, even by clumſy Fingers: But in the Formation of theſe, ſuch diminutive Things, ſuch Nothings, what Cun-

* *Lib.* 11. *cap.* 2.

Cunning and Curioſity! What Force and Strength was requiſite, there being in them ſuch inextricable Perfection!

To what Proofs or Examples of Spontaneous Generation may be brought from Inſects bred in the Fruits or Excreſcencies of Plants, I have already made Anſwer in my ſecond Particular, which contains the Teſtimonies of our beſt modern Naturaliſts concerning theſe Things.

In my Denial of the Spontaneous Generation of *Plants*, I am not ſo confident and peremptory; but yet there are the ſame Objections and Arguments againſt it, as againſt that of Animals, *viz.* becauſe it would be a Production out of indiſpoſed Matter, and conſequently a Creation: Or, if it be ſaid, there is diſpoſed Matter, prepar'd by the Earth, or Sun, the Heat, or whatever other Agent you can aſſign; I reply, this is to make a Thing act beyond its Strength, that is, an inferior Nature which hath nothing of Life in it, to prepare Matter for a ſuperior, which hath ſome Degree of Life; and for the Preparation of which, it hath no convenient Veſſels or Inſtruments. If it could do ſo, What need of all that *Apparatus* of Veſſels, Preparation of Seed, and, as I alſo ſuppoſe, Diſtinction of Maſculine and Feminine that we ſee in Plants? I demand farther, Whether any of the Patrons of Spontaneous Generation in Plants, did ever ſee any Herbs, or Trees, except thoſe of the Graſs-leaved Tribe, come up without two Seed-

Leaves; which, if they never did or could, it is to me a great Argument that they came all of Seed; there being no Reaſon elſe, why they ſhould at firſt produce two Seed-Leaves different from the Subſequent? And if all theſe *Species* (which are far the greateſt Number) come from Seed, there is not the leaſt Reaſon to think that any of the reſt come up ſpontaneouſly. And this, with what I have written before, may ſuffice concerning this Point.

Whereas I have often written in many Places, that ſuch and ſuch Plants are ſpontaneous, or come up ſpontaneouſly; I mean no more by that Expreſſion, but that they were not planted or ſown there induſtriouſly by Man.

Having ſpoken of the Body of Man, and the Uſes of its ſeveral Parts and Members, I ſhall add ſome other Obſervations, giving an Account of the particular Structure, Actions and Uſes of ſome Parts, either common to whole Kinds of Animals, or proper to ſome particular *Species* different from thoſe of Man, and of the Reaſon of ſome Inſtincts and Actions of Brutes.

Firſt of all, The Manner of Reſpiration, and the Organs ſerving thereto in various Animals, are accommodated to their Temper of Body, and their Place and Manner of living; of which I have obſerved in more perfect Animals three Differences:

1. The hotter Animals, which require abundance of Spirits for their various Motions and Exerciſes, are provided with Lungs, which indeſinently draw in and expel the Air alternately without Intermiſſion, and have a Heart furniſhed with two Ventricles; becauſe to maintain the Blood in that Degree of Heat, which is requiſite to the Performance of the Actions of all the Muſcles, there is abundance of Air neceſſary. I ſhall not now take Notice of the Difference that is between the Lungs of Quadrupeds and Birds, how the one are fixed and immoveable, the other looſe and moveable; the one perforated, tranſmitting the Air into large Bladders, the other encloſed with a Membrane.

It is here worth the Notice taking, that many Animals of this Kind, both Birds and Quadrupeds, will endure and bear up againſt the extremeſt Rigour of Cold that our Country is expoſed to. *Horſe, Kine* and *Sheep*, as I have experienced, will lie abroad in the open Air upon the cold Ground during our long Winter-Nights, in the ſharpeſt and ſevereſt Froſts that ever happened with us, without any Harm or Prejudice at all; whereas one would think, that at leaſt the Extremities of their Members ſhould be bitten, benummed and mortified thereby. Conſidering with myſelf by what Means they were enabled to do this, and to abide and reſiſt the Cold, it occurr'd to my Thoughts, that the Extremities of their Toes were fenc'd with Hoofs, which in good Meaſure ſecured them: But the main Thing was, that the Cold is, as it were, its own Antidote; for the Air being fully charged and ſated with nitrous, or ſome other Sort of Particles (which are the great Efficients of Cold, and no leſs alſo the *Pabulum* of Fire) when inſpired, doth by Means of them cauſe a great Accenſion and Heat in the Blood (as we ſee Fewel burns raſhly in ſuch Weather) and ſo enable it to reſiſt the Impreſſions of the Cold for ſo ſhort a Time as its more nimble Circulation expoſes it thereto, before it comes to another Heating. From hence may an Account be given, why the Inhabitants of hot Countries may endure longer Faſting and Hunger, than thoſe of colder; and thoſe ſeemingly prodigious, and to us ſcarce credible, Stories of the Faſtings and Abſtinence of the *Egyptian* Monks be render'd probable.

2. Other Animals, which are of a colder Temper, and made to endure a long *Incdia*, or Faſting, and to lie in their Holes almoſt torpid all Winter: As all Kinds of *Serpents* and *Lizards*, have indeed Lungs, but do not inceſſantly breathe, or when they have drawn in the Air, neceſſarily expire it again, but can retain it at their Pleaſure, and live without Reſpiration whole Days together, as was long ſince experimented by Sir *Thomas Brown*, M. D. in a Frog tied by the Foot under Water for that Purpoſe by him. This Order of Creatures have but one Ventricle in their Hearts; and the

whole Blood doth not ſo often circulate through the Lungs, as it doth through the reſt of the Body. This Manner of Breathing is ſufficient to maintain in them that Degree of Heat which is ſuitable to their Nature and Manner of Living. For to our Touch they are always cold even in Summer-time, and therefore ſome will then put Snakes into their Boſom to cool them.

3. Fiſhes, which were to live and converſe always in a cold Element, the Water, and therefore were to have a Temper not excelling in Heat, becauſe otherwiſe the conſtant immediate Contract of the Water (unleſs ſome extraordinary Proviſion were made) could not have been ſupported by them, that they might not be neceſſitated continually to be coming up to the Top of the Water to draw in the Air, and for many other Reaſons that might be alledged, perform their Reſpiration under Water by the Gills, by which they can receive no more Air than is diſperſed in the Pores of the Water, which is ſufficient to preſerve their Bodies in that Temper of Heat that is ſuitable to their Nature, and the Place wherein they live. Theſe alſo have but one Ventricle in their Hearts.

But now, though this be thus, the Great and moſt Wiſe GOD, as it were, purpoſely to demonſtrate, That he is not by any Condition, or Quality of Place, neceſſarily determined to one Manner of Reſpiration, or one Temper of

Body in Fiſhes; he hath endued the Bodies of ſome of that Tribe of Aquatick Creatures with Lungs like Viviparous Quadrupeds, and two Ventricles of the Heart, and an Ability of Breathing like them, by drawing in and letting out the open Air; ſo contriving their Bodies, as to maintain, in the midſt of the cold Water, a Degree of Heat anſwerable to that of the forementioned Quadrupeds.

Another remarkable Thing relating to Reſpiration, is the keeping the Hole, or Paſſage, between the *Arteria Venoſa* and *Vena Cava*, called *Foramen Ovale*, open in ſome amphibious Quadrupeds, *viz.* the *Phoca*, or *Vitulus Marinus*, called in the *Engliſh*, *Sea-Calf* and *Seal*; and, as is generally held, the *Beaver* too. We have already given the Reaſon of the twofold Communication of the great Blood-Veſſels in the *Fœtus*, or Young, ſo long as it continues in the Womb: The one between the two Veins entring the Heart, by a Hole, or Window; the other between the two Arteries, by an Arterial Chanel, extended from the Pulmonary Artery to the *Aorta*, or great Artery; which was, in brief, to divert the Blood from the Lungs. The ſame Reaſon for keeping open this *Floramen Ovale*, there is, in theſe amphibious Creatures; For, 1. The Lungs probably being not extended, but emptied of Air when they abide long under Water, and flacid, it is not eaſy for the whole Blood every Circulation to make its Way through them. 2. To maintain that Degree of Heat and Motion in the Blood, as is ſufficient for them while they are under Water, there is not ſo much Air required, as is when they are above; the Blood then moving but gently, as doth that of the *Fœtus* in the Womb.

Farther, in reference to Reſpiration, it is obſerved by the *Pariſian* Academiſts, that ſome amphibious Quadrupeds, particularly the *Sea-Calf*, or *Seal*, hath his *Epiglottis* extraordinarily large in proportion to other Animals, it extending half an Inch in length beyond the *Glottis* to cover it. I believe the *Beaver* hath the like *Epiglottis*, exactly cloſing the *Larynx*, or *Glottis*, and hindring all Influx of Water; becauſe in one diſſected by *Wepferus*, that ſuffocated itſelf in the Water, there was not a Drop of Water found in the Lungs. It is probable (*ſay they*) that this is done more exactly to cloſe the Entrance of the *Aſpera Arteria*, or Wind-Pipe, when the Animal eats his Prey at the Bottom of the Sea, and to hinder the Water from running into his Lungs. An Elephant (as is obſerved by Dr. *Moulins*, I think, in the Anatomy of that Creature) hath no *Epiglottis* at all, there being no danger of any Thing falling into their Lungs from eating or drinking, ſeeing there is no Communication between the *Oeſophagus* and it. For he thus deſcribes the *Oeſophagus*, or Gullet: The Tongue of this Creature (*ſaith he*) had this peculiar in it, that the Paſſage to the Ventricle was through it; for there was a Hole near the Root of it, and exactly in the middle of that

Part; which Hole was the Beginning of the *Oeſophagus.* There was no Communication between this and the Paſſage into the Lungs, contrary to what we may obſerve in Men, in all Quadrupeds and Fowl, that ever I had Opportunity to diſſect. For the *Membrana pituitaria anterior* reached to the very Root of the Tongue below the *Oeſophagus*, and ſo quite ſtopped the Paſſage of the Air into the Mouth. But though there be no danger of Meat or Drink falling into the Lungs, yet were they not ſufficiently ſecured from ſmall Animals creeping in there: For though, to ſupply in ſome meaſure the Want of an *Epiglottis* by leſſening the *Glottis*, there grew to the Outſide of the Cartilages, called *Arytenoides*, another capable of Motion up and down, by the Help of ſome Muſcles that were implanted in it, ſtrong on both Sides of the *Aſpera Arteria*, but on the Under-ſide, oppoſite to that of the *Oeſaphagus*, very limber, wanting about two Inches and a half of coming round the aforeſaid Cartilages on the Upper-ſide, or the next to the *Oeſophagus*: Yet did not this Cartilage ſo ſhut up the Way againſt them, but that even a *Mouſe* creeping up his *Proboſcis* might get into his Lungs, and ſo ſtifle him. Whence we may gueſs at the Reaſon, why the *Elephant* is afraid of a *Mouſe*: And, therefore, to avoid this Danger, this Creature [the Elephant, which this Author deſcribed] was obſerved always when he ſlept to keep his Trunk [*Proboſcis*] ſo cloſe to the Ground, that nothing but Air could get in between them. This is a ſtrange Sagacity and Providence in this Animal, or elſe an admirable Inſtinct.

Again, The *Pariſian* Academiſts obſerve of the *Sea-Tortoiſe*, that the Cleft of the *Glottis* was ſtrait and cloſe: Which exact Encloſure, I do rather believe, is to prevent the Water from entring into the Wind-Pipe, when the Tortoiſes are under Water, than to aſſiſt the Effect of the Compreſſion of the Air in the Lungs, as they would have it. For they make the main Reaſon of Reſpiration, and Uſe of the Lungs in this Creature, to be, to take in and retain Air; by the Compreſſion and Dilatation whereof, made by the Muſcles, it can raiſe or ſink itſelf in the Water, as need requires; though I do not exclude this. But if this be the main Uſe of the Lungs and Reſpiration in this Animal, what is it in Land-Animals, which have a like Conformation of Lungs, and Manner of Reſpiration, as the *Camelion*, *Serpents*, and *Lizards?*

But before I diſmiſs the Tortoiſe, I ſhall add two notable Obſervations concerning him, borrowed of the ſaid *French Academiſts*, which ſeem to argue ſomething of Reaſon in him, and more than a bare Inſtinct. The firſt is in the *Land-Tortiſe*; and it is his Manner of turning himſelf, and getting upon his Feet again when he is caſt upon his Back, which they deſcribe in theſe Words: *At the great Aperture of the Shell before, there was at the Top a raiſed Border, to grant more Liberty to the Neck and*

and Head, for lifting themſelves upwards. And this Inflection of the Neck is of great Uſe to the Tortoiſes. For it ſerves them to turn again, when they are upon their Backs. And their Induſtry upon this Account is very admirable. We have obſerved in a living Tortoiſe, *that being turned upon its Back, and not being able to make Uſe of its Paws for the returning of itſelf, becauſe they could not only bend towards the Belly, it could help itſelf only by its Neck and Head, which is turned ſometimes on one ſide, ſometimes on the other, by puſhing againſt the Ground, to rock itſelf as in a Cradle, to find out the ſide towards which the Inequality of the Ground might more eaſily permit it to rowl its Shell. For when it had found it, it made all its Endeavours on that Side.*

The Second is in the *Sea-Tortoiſe*, as follows: *Ariſtotle* and *Pliny* have remarked, that when *Tortoiſes* have been a long time upon the Water during a Calm, it happens that their Shell being dried in the Sun, they are eaſily taken by the Fiſhermen; by reaſon they cannot plunge into the Water nimbly enough, being become too light. This ſhews what Equality there ought to be in their *Æquilibrium*, ſeeing ſo little a Change as this, which may happen by the ſole Drying of the Shell, is capable of making it uſeleſs. This Eaſineſs to be taken at ſuch a time, theſe *Academiſts* do not referr meerly to the Lightneſs of this Creature's Body, (for he could eaſily let Air enough out of his Lungs to render it heavier than the Water, and ſo enable himſelf to ſink) but to a wonderful Sagacity and Caution of this Animal. For (*ſay they*) it is probable that the *Tortoiſe*, which is always careful to keep himſelf in this *Æquilibrium*, ſo as other Animals are to keep themſelves on their Legs, in this caſe, by the ſame Inſtinct, dares not let the Air out of his Lungs, to acquire a Weight which might make him ſpeedily to ſink; becauſe he fears that his Shell being wet, it ſhould become ſo heavy, that he being ſunk to the Bottom of the Water, might never have Power afterwards to re-aſcend. If this may be the Reaſon why he expoſes himſelf to the Danger of being taken at ſuch a time, rather than he will deſcend ſuddenly to the Bottom, it is clear, that he is endued with an admirable Providence and Foreſight, and a Power of Augmentation.

That Nature doth really deſign the Preſervation and Security of the more infirm Creatures, by the defenſive Armor that it hath given to ſome of them, together with Skill to uſe it, is, I think, demonſtrable in the common *Hedge-hog*, or *Urchin*, and one *Species* of *Taton*, or *Armadillo*. The *Hedge-hog* hath his Back-ſides and Flanks thick ſet with ſtrong and ſharp Prickles, and beſides, by the Help of a Muſcle, given him for that Purpoſe, is enabled to contract himſelf into a Globular Figure, and ſo to withdraw, encloſe and hide his whole Under-part, Head, Belly, and Legs, (which, for the Neceſſities and Conveniencies of Life, muſt be left deſtitute of this Armor) within his Covert or Thicket of Prickles; ſo that Dogs, or other rapacious Creatures, cannot lay hold upon him, or bite him, without wounding their own Noſes and Mouths. The Muſcle, whereby he is enabled to draw himſelf thus together, and gather up his whole Body like a Ball, the *Pariſian Academiſts* deſcribe to be a diſtinct Carnoſe Muſcle, extended from the *Oſſa Innominata* to the Ear and Noſe, running along the Back-bone, without being faſtened thereto. *Olaus Borrichius*, in the *Danick* Tranſactions, makes it to be an almoſt Circular Muſcle, embracing the *Panniculus Carnoſus*, of a wonderful Fabrick, variouſly extending its *Laciniæ*, or Proceſſes, to the Feet, Tail, and Head of the Creature.

The other Creature, which doth thus contract and draw up itſelf into a Globular, or Oval, Figure for its Defence, is the ſecond Sort of *Tatou*, or *Armadillo*, largely deſcribed by *Marcgrave*, *Lib. 6. cap. 9.* by the Name of *Tatu Apara*, which is covered on its Back and Sides with a ſtrong ſcaly Cruſt, or Shell, of a hard or bony Subſtance, jointed like Armor, or the Scales of the Tale of a Lobſter, by four tranſverſe Commiſſures in the Middle of the Body, connected by tough Membranes. When it ſleeps, (as it doth for the moſt Part in the Day-time, going forth to feed in the Night) or when one goes about to lay hold on it, gathering up its fore and hind Legs as it were to one Point, and drawing its Ears with its Head inward, and bringing its Tail to its Head, by reaſon of the fore-mentioned Commiſſures, it bends its Back ſo far, till its Head comes to touch its hind Part, and ſo with Armor gather itſelf into a round Ball, the lateral Extremities of the Shell touching one another, and encloſing the Body on the Sides; and the fore and hind Parts coming ſo near together, that there is nothing to be ſeen, but the Armature of the Head and Tail, which, like Doors, ſhut up the Hole, which the Shells of the Body left open. This it performs by the Action of a notable Muſcle on each ſide, of a great Length, having the Form of the Letter X, made up of many Fibres, decuſſating one another longways; by the help whereof, it can contract its Shell, and hold it contracted with ſuch a mighty Force, that he muſt be a ſtrong Man indeed that is able to open it.

Had ſuch a Muſcle as this, and ſuch an Ability of Contraction been given to any Creature that was cover'd with ſoft Hair, or Fur, there might have been ſome Pretence to fancy, that this was accidental and not deſigned: But ſeeing there is not one Inſtance of this Kind in Nature, it muſt be great Stupidity to believe it, and an Impudence to aſſert it. Neither will the Atheiſts uſual κρησφύγετον, or Refuge, *That there were indeed at firſt ſuch Creatures produc'd; but being obnoxious to thoſe that were ſtrong and rapacious, they were by degrees deſtroyed, and the Race loſt*, here help them out: Becauſe ſuch a Muſcle and Faculty of uſing it to that Purpoſe, might as likely have fallen to the Lot, or Chance, of a ſtrong and generous

Creature, which others dared not approach to hurt, who might, for his own Diſport, have thus contracted himſelf into a Ball, of which Kind we find none.

I have before mentioned the Uſe aſſigned by the Honourable Mr. *Boyle*, of famous Memory, lately deceas'd, to the *Periophthalmium*, or nectating Membrane in Brutes, wherein I could not fully acquieſce as to ſome Quadrupeds, which were in no danger of having their Eyes harmed by Buſhes, and Prickles, or Twigs of Trees; ſince the Writing whereof, I have met with a different Account of the Uſe of that Membrane, in the *Anatomical Deſcription of ſeveral Creatures diſſected by the Royal Academy of Sciences at* Paris, Engliſh'd by Mr. *Alexander Pitfield, p.* 249. in the Deſcription of the *Caſſowar.* Our Opinion (*ſay thoſe Academiſts*) is, that the Membrane ſerves to clean the *Cornea*, and to hinder, that by drying, it grow no leſs tranſparent. Man and the Ape, which are the ſole Animals wherein we have not found this Eye-lid, have not wanted this Proviſion for the cleanſing of their Eyes, becauſe that they have Hands, with which they may, by rubbing their Eye-lids, expreſs the Humidity which they contain, and which they let out thro' the *Ductus Lacrymalis*: Which is known by Experience, when the Sight is darkned, or when the Eyes ſuffer any Pain, or Itching: For theſe Accidents do ceaſe, when the Eyes are rubbed.

But the Diſſection has diſtinctly diſcovered to us the Organs which do particularly ſerve for this Uſe, and which are otherwiſe in Birds, than in Man, where the *Ductus* paſſes not beyond the *Glandula Lachrymalis.* For in Birds it goes beyond; and penetrating above half way on the internal Eye-lid, it is opened underneath upon the Eye: Which is evidently done to ſpread a Liquor over the whole *Cornea*, when this Eye-lid paſſes and repaſſes; as we obſerv'd it to do every Moment.

The Artifice and Contrivance of Nature, for the extending and withdrawing of this Curtain of the *Periophthalmium* in Birds, is admirable; but it is difficult ſo to expreſs it in Words, as to render it intelligible to the Reader; for a Multitude of Words doth rather obſcure than illuſtrate, they being a Burden to the Memory, and the firſt apt to be forgotten, before we come to the laſt. So that he that uſes many Words for the explaining any Subject, doth, like the *Cuttle-Fiſh*, hide himſelf, for the moſt Part, in his own Ink. And in the Deſcription of the Figure, and Manner of the Extenſion and Contraction of this Membrane, the *Pariſian Academiſts* are conſtrained to uſe ſo many Words, that I am afraid few Readers Patience and Attention will laſt ſo long, as to comprehend and carry it away: Yet becauſe it is ſo evident and irrefragable a Proof of Wiſdom and Deſign, I could not omit it. Their Words are theſe, The Particularities of the admirable Structure of this Eye-lid, are ſuch Things as do diſtinctly diſcover the Wiſdom of Nature, among a thouſand others, of which we perceive not the Contrivance, becauſe we underſtand them only by the Effects, of which we know not the Cauſes; but we here treat of a Machine, all the Parts whereof are viſible, and which need only to be look'd upon, to diſcover the Reaſon of its Motion and Action.

This Internal Eye-lid in Birds is a Membranous Part, which is extended over the *Cornea*, when it is drawn upon it like a Curtain, by a little Cord, or Tendon; and which is drawn back again into the great Corner of the Eye, to uncover the *Cornea*, by the Means of the very ſtrong Ligaments that it has, and which, in drawing it back towards its Origine, do fold it up. It made a Triangle when extended, and it had the Figure of a Creſcent when folded up. Its *Baſis* (which is its Origine) was toward the great Corner of the Eye, at the Edge of the great Circle, which the *Sclerotica* forms when it is flatted before, making an Angle with its anterior Part, that is, the *Cornea*, which is raiſed like a Hill upon it. The *Baſis*, which is the Part immoveable, and faſtned to the Edge of the *Sclerotica*, did take up more than a third Part of the Circumference of the great Circle of the *Sclerotica*: The Side of the Triangle, which is toward the little Corner of the Eye, and is moveable, was reinforced with a Border, which ſupplies the Place of the *Tarſus*, and which is black in moſt Quadrupeds. This Side of the Eye-lid is that which is drawn back into the Corner of the Eye, by the Action of the Fibres of the whole Eye-lid, which parting from its Origine, proceed to join themſelves to its *Tarſus.*

To extend this Eye-lid over the *Cornea*, there were two Muſcles that were ſeen, when ſix were taken away, which ſerv'd to the Motion of the whole Eye. We found that the greateſt of theſe two Muſcles has its Origine at the very Edge of the great Circle of the *Sclerotica*, towards the great Corner, from whence the Eye-lid takes its Original. It is very fleſhy in its Beginning, which is a large *Baſis*, from whence coming inſenſibly to contract itſelf by paſſing under the Globe of the Eye, like as the Eye-lid paſſes over it, it approaches the Optick Nerve, where it produces a Tendon round and ſlender, ſo that it paſſes through the Tendon of the other Muſcle, which ſerves for a Pully, and which hinders it from preſſing the Optick Nerve upon which it is bent, and makes an Angle, to paſs through it to the upper Part of the Eye; and coming out from underneath the Eye to inſert itſelf at the Corner of the Membrane, which makes the Internal Eye-lid. This ſecond Muſcle hath its Original at the ſame Circle of the *Sclerotica*, but oppoſite to the firſt towards the little Corner of the Eye, and paſſing under the Eye like the other, goes to meet it, and embraces its Tendon, as has been declared.

The Action of theſe two Muſcles is, in reſpect to the firſt, to draw by the Means of its Cord or Tendon the Corner of the Internal Eye-lid, and to extend it over the *Cornea.* As to the ſecond Muſcle, its Action is by making its Tendon to approach towards its Origine, to hinder the Cord of the firſt Muſcle which it embraces, from hurting the Optick Nerve; but its principal Uſe is, to aſſiſt the Action of the firſt Muſcle. And it is herein that the Mechaniſm is marvellous in this Structure, which makes that theſe two Muſcles joined together, do draw much farther than if it had but one. For the Inflection of the Cord of the firſt Muſcle, which cauſes it to make an Angle on the Optick Nerve, is made only for this End: And a ſingle Muſcle with a ſtrait Tendon, had been ſufficient, if it had Power to draw far enough. But the Traction which muſt make the Eye-lid extend over the whole *Cornea*, being neceſſarily great, it could not be done but by a very long Muſcle; and ſuch a Muſcle not being able to be lodg'd in the Eye all its Length, there was no better Way to ſupply the Action of a long Muſcle, than by that of two indifferent ones, and by bending one of them, to give it the greater Length in a little Space. Thus far the *Academiſts*, who themſelves reflecting on the Length and Obſcurity of this Deſcription, tell us, that the Inſpection of the Figure, will ſerve greatly to the Underſtanding of it, which the Novelty of the Thing renders obſcure in itſelf; and ſo I fear it will be to moſt Readers; howbeit in ſuch a Work as this, I ought not by any means, as I ſaid before, to leave out ſuch a notable Inſtance, wherein Contrivance and Deſign do ſo clearly and undeniably appear.

The ſame *Academiſts*, as I remember, tell us, That they have found by Experience, that the aqueous Humour of the Eye will not freeze; which is very admirable, ſeeing it hath the Perſpicuity and Fluidity of common Water, and hath not been taken Notice of, ſo far as I have heard, to have any eminent Quality diſcoverable, either by Taſte or Smell; ſo that it muſt be of ſome ſingular and ethereal Nature: And deſerves to be examined and annalized by the curious Naturaliſts of our Times.

The Providence of Nature is wonderful in a *Camel*, or *Dromadary*, both in the Structure of his Body, and in the Proviſion that is made for the Suſtenance of it. Concerning the firſt, I ſhall inſtance only in the Make of his Foot, the Sole whereof, as the *Pariſian Academiſts* do obſerve, is flat and broad, being very fleſhy, and covered only with a thick, ſoft, and ſomewhat callous Skin, but very fit and proper to travel in ſandy Places; ſuch as are the Deſarts of *Africk* and *Aſia*. We thought (ſay they) that this Skin was like a living Sole, which wore not with the Swiftneſs and the Continuance of the March, for which this *Animal* is almoſt indefatigable. And it may be this Softneſs of the Foot, which yields and fits itſelf to the Ruggedneſs and Uneavenneſs of the Roads, does render the Feet leſs capable of being worn, than if they were more ſolid.

As to the Second, the Proviſion that is made for their Suſtenance in their continued Travels over ſandy Deſarts, the ſame Academiſts obſerve, That at the Top of the ſecond Ventricle (for they are ruminant Creatures, and have four Stomachs) there were ſeveral ſquare Holes, which were the Orifices of about twenty Cavities, made like Sacks placed between the two Membranes, which do compoſe the Subſtance of this Ventricle. The View of theſe Sacks made us to think, that they might well be the Reſervatories, where *Pliny* ſays, That Camels do a long time keep the Water, which they drink in great Abundance when they meet with it, to ſupply the Wants which they may have thereof in the dry Deſarts, wherein they are uſed to travel; and where it is ſaid, that thoſe that do guide them, are ſometimes forced, by Extremity of Thirſt, to open their Bellies, in which they do find Water.

That ſuch an Animal as this, ſo patient of long Thirſt, ſhould be bred in ſuch droughty and parched Countries, where it is of ſuch eminent Uſe for travelling over thoſe dry and ſandy Deſarts, where no Water is to be had ſometimes in two or three Days Journey, no candid and conſiderable Perſon but muſt needs acknowledge to be an Effect of Providence and Deſign.

Such Animals as feed naturally upon Fleſh, both Quadrupeds and Birds, becauſe ſuch kind of Food is high and rank, do qualify it, the one by ſwallowing the Hair or Fur of the Beaſts they prey upon, the other by devouring ſome Part of the Feathers of the Birds they gorge themſelves with, not electively, but becauſe they cannot, or will not, take the Pains fully to plume them. And therefore the *Pareſian Academiſts* do rationally refer the Death of one of the Lions whom they diſſected, to the feeding of him with too ſucculent and delicate Meat. For (ſay they) we know, that ſome time before his Death he was ſeveral Months without going out of his Den, and that it was hard to make him eat. That for this Reaſon ſome Remedies were preſcribed to him, and among others the eating only the Fleſh of young Animals, and thoſe alive. And that thoſe which look'd to the Beaſts of the Park of *Vicennes*, to make this Food more delicate, did uſe a Method very extraordinary; which was, they flead Lambs alive, and thus made him eat ſeveral; which at the firſt revived him, creating in him an Appetite, and making him brisk. But it is probable that this Food engender'd too much Blood, and which was too ſubtile for an Animal to whom Nature had not given the Induſtry of fleaing thoſe which he eat. It being credible, That the Hair, Wool, Feathers and Scales, which all Animals of Prey do ſwallow, are a ſeaſonable and neceſſary corrective, to prevent their Greedineſs from filling themſelves with too ſucculent a Food.

Though I have declared in the Beginning of this Work, that the Means whereby cartilaginous

nous Fiſhes raiſe and ſink themſelves in the Water, and reſt and abide in what Depth they pleaſe, is not yet certainly known; yet I ſhall propound a Conjecture concerning it, which was firſt ſuggeſted to me by Mr. *Peter Dent*, late Phyſician in *Cambridge*, *viz.* That it is by the Help of Water which they take in and let out by two Holes in the lower Part of their *Abdomen*, or Belly, near the Vent, or not far off it. The Fleſh of this Sort of Fiſh being lax and ſpungey, and nothing ſo firm, ſolid and weighty, as that of the Bony Fiſhes; and there being a good Quantity of Air contained in the Cavity of their *Abdomen*, they cannot ſink in the Water, without letting in ſome of it by theſe Holes (the Orifices whereof are opened and ſhut at Pleaſure by the Help of Muſcles provided for that Purpoſe) into the Hollow of their Bellies, whereby they preponderate the Water, and deſcend; and when they would aſcend by a Compreſſion wrought by the Muſcles of the *Abdomen*, they force out the Water again, or at leaſt ſo much of it as may ſuffice to give that Degree of Levity they need or deſire. If it be found, by Experience, that the Bodies of theſe Fiſhes, without this Ballaſt, would naturally float in the Water, and that they do really admit Water into their Bellies, then this Conjecture may have ſome Probability or Truth in it, otherwiſe not.

Upon the Contemplation and Conſideration of thoſe various Ways and Contrivances which Nature (I mean the Divine Wiſdom) hath made uſe of for preparing the Chyle, ſeparating the nutritious Juice from the groſſer Parts of the Aliment, and the ſeveral Humours and Spirits from the Blood, I cannot but admire her great Wiſdom, Art, and Curioſity. For ſhe hath not only employed all thoſe Methods and Devices, which Chymiſts have either learned by Imitation of her, or invented of themſelves, for annalizing of Bodies, ſeparating their Parts, the pure from the impure, and extracting their Spirits, *&c.* as *Maceration* in the firſt Stomach, or Paunch, of ruminating Creatures, and in the Craws of Birds; *Comminution* by grinding in the Mouths of viviparous Quadrupeds, and in the Gizzards of Poultry; *Fermentation* in the Stomachs of moſt Terreſtrial, and all Aquatick Animals; *Expreſſion* and Squeezing, in the *Omaſus* of ruminant Quadrupeds, and in the Inteſtines of all Creatures, by the Motion of the Midriff, and other Muſcles of the Belly, forcing the Chyle out of the *Fæces*, or Excrements, into the Lacteal Veins; *Straining*, or *Percolation*, by all the *Viſcera* of the Body; which are but as ſo many Colanders to ſeparate ſeveral Juices from the Blood: And, laſtly, *Digeſtion* and *Circulation*, in the Spermatick Parts and Veſſels, and perhaps alſo in the Brain. I ſay, it hath not only made uſe of theſe Operations, but it hath quite out-done the Chymiſts, effecting that by a gentle Heat, which they cannot perform without great Streſs of Fire. As for Inſtance, in the Stomach of a Dog, preparing a Liquor that diſſolves Bones; and in the Bodies of ſome Inſects, a Liquor which ſeems to be as highly acid and corroſive, as Oil of Vitriol, or Spirit of Nitre, *viz.* that which is inſtilled into the Blood when they ſting. It is an Experiment I have met with in ſome Books, and made myſelf, that if you put Blue-Bottles, or other blue Flowers into an Ant-Hill, they will preſently be ſtained with red: The Reaſon (which theſe Authors render not) is, becauſe the Ants thruſt in their Stings into the Flowers, and inſtil into or drop upon them a ſmall Mite of their ſtinging Liquor, which hath the ſame Effect that Oil of Vitriol would have in changing their Colour, which is a Sign that both Liquors are of the ſame Nature.

Caſper Bartholine hath obſerved, That where the Gullet perforates the Midriff, the carneous Fibres of that muſcular Part are inflected and arcuate, as it were a *Sphincter* embracing and cloſing it faſt, by a great Providence of Nature, leſt in the perpetual Motion of the Diaphragm, the upper Orifice of the Stomach ſhould gape, and caſt out the Victuals as faſt as it received it. And *Peyerus* thinks he hath obſerved, that in ruminating Creatures the Connection of the Gullet with the Diaphragm is far ſtraiter and ſtronger than in Man and other Animals, to the End that there ſhould not be more than one Morſel forced out at once. For that external Sphincter inhibits a too great Dilatation of the Gullet, and doth as it were meaſure out the Morſels, and fit them to the Capacity of the *Oeſophagus.*

I ſhall conclude with a notable Relation of *Galen*'s, *Lib. 6. de locis effectis, cap. 6.* concerning a Kid taken by him alive out of the Dam's Belly, and nouriſhed and brought up.

Ἡ διαπλάσασά τε καὶ τελειώσασα φύσις εἰργάσατο χωρὶς διδασκαλίας ἐπὶ οἰκείαν ἐνέργειαν ἔρχεσθαι· καὶ βάσανόν γε τούτου μεγίστην ἐποιησάμην ποτὲ θρέψας ἔριφον, ἄνευ τοῦ θεάσασθαί ποτε τὴν κυήσασαν· αἶγας γὰρ ἐγκύμονας ἀνατεμὼν ἕνεκα τῶν ἐζητημένων θεωρημάτων τοῖς ἀνατομικοῖς ἀνδράσι περὶ τῆς κατὰ τὸ κυούμενον οἰκονομίας, εὑρὼν ποτὲ γενναῖον τὸ ἔμβρυον, ἀπέλυσα μὲν τῆς μήτρας ὥσπερ εἰώθαμεν· ἁρπάσας δὲ πρὶν θεάσασθαι τὴν κυήσασαν εἰς οἶκον μὲν τινα κομίσας κατέθηκα, πολλὰ μὲν ἔχοντα λεκάνια· τὸ μὲν οἴνου, τὸ δὲ ἐλαίου, τὸ δὲ μέλιτος, τὸ δὲ γαλακτος, ἢ ἄλλου τινὸς ὑγροῦ πλῆρες, οὐκ ὀλίγα δ᾽ ἄλλα τῶν Δημητρίων καρπῶν, ὥσπερ δὲ καὶ τῶν ἀκροδρύων· ἐθεασάμεθα δὲ τὸ ἔμβρυον ἐκεῖνο, πρῶτον μὲν βαδίζον τοῖς ποσὶν, ὥσπερ ἀκηκοὼς ἕνεκα βαδίσεως ἔχειν τὰ σκέλη· δέυτερον δὲ ἀποσειόμενον τὴν ἐκ τῆς μήτρας ὑγρότητα, καὶ τρίτον ἐπὶ τούτῳ κυσάμενον ἑνὶ τῶν ποδῶν τὴν πλευρὰν, εἶτ᾽ ὀσμώμενον εἴδομεν αὐτὸ τῶν κειμένων κατὰ τὸν οἶκον ἑκάστου, ὡς δὲ πάντων ὠσμᾶτο τοῦ γάλακτος ἀπερόφησεν, ἐν ᾧ καὶ ἀνεκράγαμεν ἅπαντες, ἐναργῶς ὁρῶντες ὅπερ Ἱπποκράτης ἔφη, φύσεις ζώων ἀδίδακτοι. **Καὶ** τοίνυν καὶ ἀνεθρεψάμην ἐκεῖνο τὸ ἐρίφιον, εἴδομέν τε προσφερόμενον ὕστερον οὐ τὸ γάλα μόνον, ἀλλὰ καὶ ἄλλα τινὰ τῶν κειμένων· ὄντος δὲ τοῦ καιροῦ καθ᾽ ὃν ἐξηρέθη τῆς μητρὸς ὁ ἔριφος, ἐγγὺς τῆς εἰαρινῆς ἰσημερίας, μετὰ δύο που μῆνας εἰσεκομισάμην αὐτῷ μαλακοὺς ἀκρέμονας θάμνων τε καὶ φυτῶν, ὧν πάλιν καὶ αὐτῶν ὀσμησάμενον ἁπάντων, ἐνίον μὲν εὐθέως ἀπέϛη, τινῶν δὲ ἠζίωσε γεύσασθαι, καὶ γευσὰ ἐνίων ἐπὶ τὴν ἐδωδὴν ἐτράπετο τῶν καὶ ταῖς μεγάλαις αἶζὶ συνήθων ἐδεσμάτων. Ἀλλὰ τȣ̃το μὲν ἴσως μικρόν· ἐκεῖνο δὲ μέγα. Τὰ κὰρ φύλλα καὶ τȣ̀ς μαλακȣ̀ς ἀκρέμονας ἀποφαγὼν κατέπιεν· εἶτ' ὀλίγον ὕϛερον ἐπὶ τὸ μηρυκάζειν ἧκεν, ὃ πάλιν θεασάμενοι πάντες ἀνεβόησαν ἐκπλαγνέτες ἐπὶ ταῖς τῶν ζώων δυνάμεσι· μέγα μέν γὰρ ἦ καὶ τὸ πεινῆσαν διά τε τȣ̃ ϛόματος καὶ τῶν ὀδόντων προσφέρεσθαι τὴν ἐδωδήν· ἀλλ' ὅτε τὸ καταποθὲν εἰς τὴν γαϛέρα πρῶτον μὲν ἀναφέρειν εἰς τό ϛόμα προσήκεν, ἔπειτα λεαίνειν ἐν ἀυτῷ μασσώμενον ἐν χρόνῳ πόλλῳ, καὶ μετὰ ταῦτα καταπίνειν μηκέτι εἰς τὴν ἀτὴν κοιλίαν, ἀλλ' εἰς ἑτέραν, ἱκανῶς ἡμῖν ἐφαίνετο θαυμάσιον εἶναι. Παρορῶσι δὲ πολλοὶ τὰ τοιαῦτα τῆς φύσεως ἔργα, μόνα τὰ ξένα θεάματα θαυμάζοντες. That is to ſay,

Nature forming, faſhioning, and perfecting the Parts of the Body, hath ſo brought it to paſs, that they ſhould of themſelves, without any teaching, ſet about and perform their proper Actions: And of this I once made a great Experiment, bringing up a Kid without ever ſeeing its Dam. For diſſecting ſome Goats great with Young, to reſolve ſome Queſtions made by Anatomiſts, concerning the Oeconomy of Nature in the Formation of the Fœtus *in the Womb; and finding a brisk* Embryon, *[young one] I looſed it from the* Matrix *after our uſual Manner, and ſnatching it away, before it ſaw its Dam, I brought it into a certain Room; having many Veſſels full, ſome of Wine, ſome of Oil, ſome of*

Honey, ſome of Milk, or ſome other Liquor; and others, not a few, filled with all Sorts of Grain, as alſo with ſeveral Fruits, and there laid it. This Embryon *we ſaw firſt of all getting up on its Feet and walking, as if it had heard, that its Legs were given it for that Purpoſe; next ſhaking off the Slime it was beſmeared with from the Womb; and moreover, thirdly, ſcratching its Side with one of its Feet; then we ſaw it ſmelling to every one of thoſe Things that were ſet in the Room; and when it had ſmelt to them all, it ſupped up the Milk; whereupon we all for Admiration cried out, ſeeing clearly the Truth of what* Hypocrates *ſaith, That the Natures and Actions of Animals are not taught, (but by Inſtinct.) Hereupon I nouriſhed and reared this Kid, and obſerved it afterwards not only to eat Milk, but ſome other Things that ſtood by it. And the Time when this Kid was taken out of the Womb being about the Vernal Equinox, after ſome two Months were brought into it the tender Sprouts of Shrubs and Plants, and it again ſmelling of all of them, inſtantly refuſed ſome, but was pleaſed to taſte others, and after it had taſted, began to eat of ſuch as are the uſual Food of Goats. Perchance this may ſeem a ſmall Thing, but what I ſhall now relate is great. For eating the Leaves and tender Sprouts, it ſwallowed them down, and then a while after it began to chew the Cud; which all that ſaw cried out again with Admiration, being aſtoniſhed at the Inſtincts and natural Faculties of Animals.*

For it was a great Thing that when the Creature was hungry, it ſhould take in the Food by the Mouth, and chew it with its Teeth; but that it ſhould bring up again into the Mouth that which it had ſwallowed down into its firſt Stomach; and chewing it there a long time, it ſhould grind and ſmooth it, afterwards ſwallow it again, not into the ſame Stomach, but into another, ſeemed to us wonderful indeed. But many neglect ſuch Works of Nature, admiring only ſtrange and unuſual Sights. So far *Galen.*

This pleaſant and admirable Story, ſhould one conſider all the Particulars of it, and endeavour to give an Account of them, as alſo all the Inferences that might be drawn from it, one might fill a whole Volume with Comments upon it. All that I ſhall at preſent ſay is this, That in all this Oeconomy, and theſe Actions, Council and Deſign doth ſo clearly appear, that he muſt needs be very ſtupid that doth not diſcern it, or impudent, that can deny it. I might add, That there ſeems to be ſomething more than can be performed by mere Mechaniſm in the Election this Creature made of its Food: For before it would eat of any, it ſmelt to all the Liquors before it, and when it had done ſo, betook itſelf to the Milk, and devoured that. He doth not ſay that the Milk was the laſt Liquor it ſmelt to; or that when it had once ſmelt to that, it preſently drank it up. The like alſo he ſaith of all the Sprouts and Branches of Plants that were laid before it. By the by, we may take Notice of one Thing very remarkable, That this Kid of its own accord drank Milk, after the manner it had done in the Womb; whereas, had it once drawn by the Nipple, it would hardly have ſupp'd the Milk. And therefore in weaning young Creatures, the beſt Way is never to let them ſuck the Paps at all, for then they will drink up Milk without any Difficulty; whereas, if they have ſuck'd, ſome will very hardly, others, by no means, be brought to drink. But how do the Young with ſuch Facility come to take the Nipple, and to ſuck at it, which they had never before uſed to do? Here we muſt have recourſe to Natural Inſtinct, and the Direction of ſome Superiour Cauſe.

Notice hath been already taken, in an Obſervation communicated by my Learned Friend Dr. *Tancred Robinſon*, of the Providence of Nature in ſo forming the Membranes of the Body, as to be capable of a prodigious Dilatation and Extenſion; which is of great Uſe in ſome Diſeaſes: For Example, the Dropſy, to continue Life for ſome time, till Remedy may be had; and if not, to give Time to prepare for Death. But the Wiſdom and Deſign of this Texture doth in no Inſtance more clearly appear, than in the Neceſſity of it for the Womb in the Time of Geſtation. For were not the Womb in Women, which, during Virginity, is not bigger than a ſmall Purſe, almoſt infinitely Dilatable, and alſo the *Peritoneum*, not to mention the Skin, and the *Cuticula*; How were it poſſible it ſhould contain the Child, nay, ſometimes Twins, with all their Appurtenances, the Secundines, the *Placenta*, the Liquor, or Waters, and what elſe is neceſſary for the Defence, Nutrition, Reſpiration, and ſoft and convenient Lodging of them, till they come to their due Perfection and Maturity for Excluſion? How could the Child have room to grow there to his Bigneſs, and ſtir and turn himſelf as is requiſite? Add hereto another Obſervation of *Blaſius*'s, particularly relating to this Subject: He hath obſerved, that the Veſſels of the interiour glandulous Subſtance of the Womb are ſtrangely contorted and reflected with Turnings and Meanders, that they might not be too much ſtrained, but their Folds being extended and aboliſhed, they might accommodate themſelves without Danger of Rupture to the neceſſary Extenſion of the Uterine Subſtance at that Time.

Another remarkable Proof of Counſel and Deſign may be fetch'd from the Formation of the Veins and Arteries near the Heart, which I meet with in Dr. *Lower*'s Treatiſe *De Corde*. Juſt before the Entrance of the right Auricle of the Heart, (*ſaith he*) to wit, where the aſcending Trunk of the *Vena Cava* meeting with the deſcending, is ready to empty itſelf into the ſaid right *Auricle*, there occurs in it a very remarkable Knob, or Bunch [*Tuberculum*] raiſed up from the ſubjacent Fat, by the Interpoſition

poſition whereof the Blood falling down by the deſcending Vein, is diverted in the Auricle, which otherwiſe encountring and bearing upon that of the aſcendent Trunk, would very much hinder and retard the Motion of it upward towards the Heart: And becauſe in an erect Site and Figure of the Body there is a greater and more eminent Danger of ſuch an Accident, therefore the *Vena Cava* in Mankind hath this Tubercle far greater, and more extant than it is in Brutes; ſo that if you thruſt your Finger into either Trunk, you can hardly find Paſſage, or Admittance into the other.

But in *Quadrupeds*, as in *Sheep*, *Dogs*, *Horſe*, *Kine*, in which the Courſe of the Blood from either Extreme of the Body is more equal, and, as it were, in a plainer Level; and becauſe the Heart, by Reaſon of its Bulk and Weight, hanging downwards, both Trunks of the *Vena Cava* have ſome little Declivity towards it, there is no need of ſo great a Bar and Diverſion in them; yet are they not altogether devoid of it.

Moreover, leſt the Blood here in its Conflux ſhould make a Kind of Flood and Whirlpool, whilſt the Auricle being contracted doth not give it free Ingreſs, therefore, in this Place, the *Vena Cava* in great Animals, as well Man as Quadrupeds, is round-about Muſculous; as well that it may be reſtrain'd and kept within its due Limits of Extenſion, as that it may more vigorouſly, and ſtrongly urge and impel the Blood into the Cavity of the *Auricle*.

Beſides, there is no leſs Providence and Caution uſed, that the Blood, when it is forcibly caſt out of the left Ventricle of the Heart, be not unequally diſtributed to the ſuperiour or inferiour Parts. For whereas this Gate or Orifice of the Heart opens right upwards, if that Channel, which receives the firſt Impulſe of the Blood, did lead in a ſtrait Line up to the Region of the Head, it could not be, but that it muſt be poured too ſwiftly upon the Brain, and ſo the inferiour Parts of the Body muſt needs be defrauded of their vital Liquor and Aliment: Which Inconvenience, that the Divine Architect of the Body might wholly obviate and avoid, in Animals, whoſe Hearts are more ſtrongly moved; he ſo artificially contrived the Trunk of the *Aorta*, which is next the Heart, that the Blood runs not directly into the Axillary and Carotide Arteries, but doth as it were fetch a Compaſs: For in the middle Space between the Ventricle and thoſe Arteries, it is very much inflected, or bent; whence it comes to paſs, that that crooked Angle ſuſtains the Force and firſt Stroke of the ejected Blood, and directs the greateſt Torrent of it towards the deſcending Trunk of the *Aorta*, which otherwiſe would ruſh too forcibly into the ſuperiour Branches thereof, diſtending them immoderately, and ſoon oppreſs and burden the Head. *So far Dr.* Lowther.

To elude, or evade, the Force of all theſe Inſtances, and innumerable others, which might be produced, to demonſtrate, that the Bodies of Men, and all other Animals, were the Effects of the Wiſdom and Power of an Intelligent and Almighty Agent, and the ſeveral Parts and Members of them deſigned to the Uſes to which now they ſerve, the *Atheiſt* hath one Subterfuge, in which he moſt confides, *viz.* That all theſe Uſes of Parts are no more than what is neceſſary to the very Exiſtence of the Things to whom they belong: And what Things made Uſes, and not Uſes Things.

> ------ *Nil ideo natum eſt in corpore ut uti*
> *Poſſemus, ſed quod natum eſt id procreat uſum.*
> Saith *Lucretius*, Lib. 4.

And having inſtanced in ſeveral Members, he concludes,

> ------ *Omnia denique membra*
> *Ante fuere, ut opinor, eorum quàm fuit uſus.*

I ſhall give you their Senſe, together with the Confutation of it, in Dr. *Bentley*'s Words, borrowed out of his Fifth Lecture, &c.

Theſe Things (*ſay* * *they*) are miſtaken for Tokens of Skill and Contrivance, whereas they are but neceſſary Conſequences of the preſent Exiſtence of thoſe Creatures to which they belong: For he that ſuppoſeth any Animals to ſubſiſt, doth, by that very Suppoſition, allow them every Member and Faculty that are neceſſary to Sub-

* *The Atheiſts.*

Subſiſtence. And, therefore, unleſs we can prove *à Priori*, and independent on this Uſefulneſs, now that Things are once ſuppoſed to have exiſted and propagated; that among almoſt infinite Trials and Eſſays at the Beginning of Things, among Millions of monſtrous Shapes, and imperfect Formations, a few ſuch Animals as now exiſt could not *poſſibly* be produced, theſe After-Conſiderations are of very little Moment: Becauſe, if ſuch Animals could in that Way *poſſibly* be formed, as might live, and move, and propagate their Beings, all this admired and applauded Uſefulneſs of their ſeveral Fabricks is but a neceſſary Condition and Conſequence of their Exiſtence and Propagation.

This is the laſt Pretence and Sophiſtry of the *Atheiſts* againſt the Propoſition in my Text, [*Acts* xvii. 27.] That we received our Life and Being from a Divine Wiſdom and Power. And as they cannot juſtly accuſe me of concealing or baulking their Grand Objection, ſo, I believe, theſe following Conſiderations will give them no Reaſon to boaſt, that it cannot receive a juſt and ſatisfactory Anſwer.

(1.) *Firſt*, therefore, we affirm that we can prove, and have done it already by Arguments *à Priori*, (which is the Challenge of the *Atheiſts*) that theſe Animals that now exiſt, could not poſſibly have been formed at firſt by Millions of Trials. For ſeeing they allow by their very *Hypotheſis*, (and without ſtanding to that Courteſy, we have proved it before) that there can be no caſual or ſpontaneous Motion of the Particles of Matter, it will follow, that every ſingle Monſter, among ſo many ſuppoſed Myriads, muſt have been mechanically and neceſſarily formed, according to the known Laws of Motion, and the Temperament and Quality of the Matter it was made of; which is ſufficient, that no ſuch Monſters were, or could have been, formed: For to denominate them even Monſters, they muſt have had ſome rude Kind of Organical Bodies, ſome *Stamina* of Life, though never ſo clumſy, ſome *Syſtem* of Parts, compounded of Solids and Liquids, that executed (though but bunglingly) their peculiar Motions and Functions. But we have lately ſhewn it impoſſible for Nature, unaſſiſted, to conſtitute ſuch Bodies, whoſe Structure is againſt the Law of Specifick Gravity: So that ſhe could not make the leaſt Endeavour towards the producing of a Monſter, or of any Thing that hath more Vital and Organical Parts than we find in a Rock of Marble, or a Fountain of Water. And again, though we ſhould not contend with them about their Monſters and Abortions, yet ſeeing that they ſuppoſe, even the perfect Animals, that are ſtill in Being, to have been formed Machanically among the Reſt, and only add ſome Millions of Monſters to the Reckoning; they are liable to all the Difficulties in the former Explication, and are expreſly refuted through the whole preceding *Sermon*, where it is abundantly ſhewn, that a Spontaneous Production is againſt the

Catholick Laws of Motion, and againſt Matter of Fact, a Thing without Example, not only in Man, and the nobler Animals, but in the Smalleſt of Inſects, and the Vileſt of Weeds: Though the Fertility of the Earth cannot be ſaid to have been impaired ſince the Beginning of the World.

(2.) *Secondly*, We may obſerve, that this Evaſion of the *Atheiſt* is fitted only to elude ſuch Arguments of Divine Wiſdom as are taken from Things neceſſary to the Conſervation of the Animal, as the Faculties of Sight, and Motion, and Nutrition, and the like; becauſe ſuch Uſefulneſs is indeed included in a general Suppoſition of the Exiſtence of that Animal, but it miſerably fails him againſt other Reaſons, from ſuch Members and Powers of the Body as are not neceſſary abſolutely to Living and Propagating, but only much conduce to our better Subſiſtance, and happier Condition. So the moſt obvious Contemplation of the Frame of our Bodies, as that we all have double *Senſories*, two *Eyes*, two *Ears*, two *Noſtrils*, is an effectual Confutation of this Atheiſtical Sophiſm. For a double Organ of theſe Senſes is not at all comprehended in the Notion of bare Exiſtence; one of them being ſufficient to have preſerved Life, and continued the Species, as common Experience witneſſeth. Nay, even the very Nails of our Fingers are an infallible Token of Deſign and Contrivance; for they are uſeful and convenient to give Strength and Firmneſs to thoſe Parts in the various Functions they are put to; and to defend the numerous Nerves and Tendons that are under them, which have a moſt exquiſite Senſe of Pain, and without that native Armour would continually be expoſed to it. It is manifeſt, therefore, that there was a Contrivance and Foreſight of the Uſefulneſs of Nails, antecedent to their Formation. For the old ſtale Pretence of the *Atheiſts*, that Things were firſt made fortuitouſly, and afterwards their Uſefulneſs was obſerved or diſcovered, can have no Place here; unleſs Nails were either abſolutely requiſite to the Exiſtence of Mankind, or were found only in ſome Individuals, or ſome Nations of Men, and ſo might be aſcribed to Neceſſity upon one Account, or to Fortune upon another. But from the *Atheiſts* Suppoſition, That among the infinite Diverſity of the firſt Terreſtrial Productions, there were Animals of all imaginable Shapes and Structures of Body, all of which ſurvived and multiplied: That by reaſon of their Make and Fabrick could poſſibly do ſo, it neceſſarily follows, That we ſhould now have ſome Nations without Nails upon their Fingers, others with one Eye only, as the Poets deſcribe the *Cyclopes* in *Sicily*, and the *Arimaſpi* in *Scythia*; others with one Ear, or with one Noſtril, or indeed without any Organ of Smelling, becauſe that Senſe is not neceſſary to Man's Subſiſtance; others deſtitute of the Uſe of Language, ſeeing that Mutes alſo may live. One People would have the Feet of Goats, as the feigned *Saytrs* and *Paniſci*:

niſci: Another would reſemble the Head of *Jupiter Ammon*, or the horned Statues of *Bacchus*; the *Scipodes* and *Enotocetæ*, and other monſtrous Nations, would be no longer Fables, but real Inſtances in Nature: And, in a Word, all the ridiculous and extravagant Shapes that can be imagined, all the Fancies and Whimſies of Poets and Painters, and *Ægyptians* Idolaters, if ſo be they are conſiſtent with Life and Propagation, would be now actually in Being, if our *Atheiſts* Notion were true: Which therefore may deſervedly paſs for a meer Dream and an Error, till they pleaſe to make new Diſcoveries in the *Terra incognita*, and bring along with them ſome Savages of all theſe fabulous and monſtrous Configurations. Thus far Dr. *Bentley*, who adds four Conſideration more to confute this Fancy, *ex abundanti*, granting the *Atheiſt* all the abſurd Suppoſitions he can make. For which, though they be very well worth the reading, yet being too long to tranſcribe, I refer the Reader to the *Sermon* itſelf.

I ſhall now farther prove by a notable Inſtance, that Uſes made Things, that is to ſay, that ſome Things were made deſignedly and on purpoſe for ſuch an Uſe as they ſerve to; and that is the Tendrels or Claſpers of Plants, becauſe they are given only to ſuch Species as have weak and infirm Stalks, and cannot raiſe up, to ſupport themſelves by their own Strength. We ſee not ſo much as one Tree, or Shrub, or Herb, that hath a firm and ſtrong Stem, and that is able to mount up and ſtand alone without

out Aſſiſtance, furniſhed with them. Whereas, had they been, without Deſign, ſcattered (as I may ſay) indifferently and careleſly among Plants, it could not poſſibly have happened, but among ſo many thouſand *Species*, they muſt have fallen to the Lot of ſome few, at leaſt, ſome one of the Strong, and not only of the Weak. The ſame hath been proved by the Inſtance of the Power given to the *Hedgehog* and *Armadillo*, of contracting their Bodies into a globular Figure, and ſo hiding and ſecuring their tender and unarmed Parts.

2. I ſhall prove by another eminent Inſtance, that Things did not make Uſes, becauſe there is a Sort of Creatures which have all the Parts and Organs which are fitted for a certain Action, and employed for the Exerciſe of it by another Sort; and yet make no uſe of them for that Purpoſe; That is, the Apekind. The *Pariſian Academiſts*, in their Anatomy of ſome Animals of this Kind, tell us, That the Muſcles of the *Os Hyoides*, *Tongue*, *Larynx*, and *Pharynx*, which do moſt ſerve to articulate a Word, were wholly like to thoſe of *Man*, and a great deal more than thoſe of the *Hand*; which, nevertheleſs, the *Apes*, which ſpeaks not, uſes with as much Perfection as a Man. Which demonſtrates, that Speech is an Action more peculiar to Man, and which more diſtinguiſhes him from Brutes, than the *Hands*, which *Anaxagoras*, *Ariſtotle* and *Galen*, have thought to be the Organ, which Nature has given to Man, as to the wiſeſt of all Animals;

for want perhaps of this Reflection: For the Ape is found provided, by Nature, of all thoſe marvellous Organs of Speech, with ſo much Exactneſs, that the very three ſmall Muſcles, which do take their Riſe from the *Apotheſis Styloides*, are not wanting, although this *Apotheſis* be extremely ſmall. This Particularity does likewiſe ſhew, That there is no Reaſon to think, that Agents do perform ſuch and ſuch Actions, becauſe they are found with Organs proper thereunto: For, according to theſe Philoſophers, Apes ſhould ſpeak, ſeeing that they have all the Inſtruments neceſſary for Speech. All this is confirmed and approved by the learned and accurate Dr. *Tyſon*, in his Anatomy of the *Orang-Outrang*, or *Pigmy*, he finding in the Animal he deſcrib'd (which was of the *Ape-kind*) the whole Structure of the *Larynx* and *Os Hyoides* exactly as 'tis in Man. And the Reflection which the *Pariſians* make upon their Obſervation of theſe, and the neighbouring Parts, he think very juſt and valuable; and adds farther, That this is not the only Inſtance, which may juſtify ſuch an Inference, though he thinks it ſo ſtrong an one, as the *Atheiſts* can never anſwer.

It is farther conſiderable, and adds to the Weight of this Inſtance, That though Birds have been taught to imitate *Humane Voice*, and to pronounce Words, yea Sentences, yet Quadrupeds never; though they have Organs far more fit for that Purpoſe, and ſome of them, *viz. Dogs*, and *Horſes*, converſe almoſt perpetually with Men; and others, as *Apes*, are given naturally to imitate Mens Actions; as if Providence had deſigned purpoſely to confute this fond Conceit of the *Atheiſts*, by denying them the Power to make uſe of theſe Organs of Speech, which, whether they underſtand what they ſaid or not, they otherwiſe might and would have done in Imitation of Man, and that to greater Perfection than Birds do, or are capable of doing.

Farther, to prove that thoſe *nobler Faculties* of the *Soul*, *Reaſon*, and *Underſtanding*, cannot be produced by Matter organized, but muſt have a higher Principle, * he thus argues; It is an Obſervation of *Veſalius*'s, that the Brain of Man, in reſpect of his Body, is much larger than what is to be met within any other Animals, exceeding in Bigneſs three Oxes Brains; whence he infers, That as Animals excel in the Largeneſs of the Brain, ſo they do likewiſe in the principal Faculties of the Soul; which Inference the Doctor cannot allow.

It is (*ſaith he*) a generally received Opinion, that the Brain is the immediate Seat of the Soul itſelf, whence one would be apt to think, that ſeeing their is ſo great a Diſparity between the Soul of a *Man*, and a *Brute*, the Organ, in which it is placed, ſhould be very different too; yet, by comparing the Brain of our *Pigmy* [the *Orang-Outrang*, or *Wild-Man*] with that of a *Man*, and with the greateſt Exactneſs obſerving each Part in both, it was

* Dr. *Tyſon*.

was very ſurprizing to me to find ſo great a Reſemblance of the one to the other, as nothing could be more; and that in Proportion to its Body, its Brain, was alſo as large as a *Man's*.

Since therefore (*he proceeds*) the Brain of our *Pigmy* does in all Reſpects ſo exactly reſemble a Man's, I might here make the ſame Reflection the *Pariſians* did upon the *Organs* of *Speech*, that there is no Reaſon to think, that Agents do perform ſuch and ſuch Actions, becauſe they are found with *Organs* proper thereunto; for then our *Pigmy* might be really a *Man*. The *Organs* in *Animal* Bodies, are only a regular Compages of Pipes and Veſſels for the *Fluids* to paſs through, and are paſſive. What actuates them, are the *Humours* and *Fluids*: And *Animal Life* conſiſts in their due and regular Motion in this Organical Body. But thoſe *nobler Faculties* in the Mind of Man, muſt certainly have a higher Principle, as *Matter organized* could never produce them: For why elſe, where the *Organ* is the ſame, ſhould not the *Action* be the ſame too?

Object. *Some may here object and argue, if the Body of Man be thus perfect, Why did God make any other Animals? For the moſt perfect Being the beſt, an infinitely good Agent, which wants neither Wiſdom nor Power, ſhould (one would think) only produce the moſt perfect.*

Anſw. To which I Anſwer, 1. That according to this Argumentation, one might infer, That God muſt produce but one Kind of Creature,

ture, and that the moſt Perfect that he is able, which is impoſſible: For he being Infinite in all Perfection, cannot act *ad extremum virium*, unleſs he could produce an Infinite Creature, that is, another God, which is a Contradiction: But whatever he makes, muſt want Degrees of Infinite Perfection, of which he could ſtill (if he pleaſed) add more and more to it.

2. The inferiour Creatures are perfect in their Order and Degree, wanting no Quality or Perfection that is neceſſary or due to their Nature and Condition, their Place and Manner of Living. Now, why God might not make ſeveral ſubordinate Ranks and Degrees of Creatures, they being good, I ſee no Reaſon.

3. Theſe ſeveral Ranks and Degrees of Creatures are ſubſervient one to another; and the moſt of them ſerviceable, and all, ſome way or other, uſeful to Man; ſo that he could not well have been without them.

4. God made theſe ſeveral Orders and Degrees, and in each Degree ſo many Varieties of Creatures, for the Manifeſtation and Diſplaying of his Infinite Power and Wiſdom. For we have ſhewn before, by a familiar Inſtance, That there is more Art and Wiſdom ſhewn in contriving and forming, a Multitude of different Kinds of Engines, than in one only.

5. Yet do I not think, that he made all theſe Creatures to no other End, but to be ſerviceable to Man, but alſo to Partake themſelves of his overflowing Goodneſs, and to enjoy their

own Beings. If we admit all other Creatures, in this inferiour World, beſides Man, to be meer Machines, or *Automata*, to have no Life, no Senſe, nor Perception of any Thing, then, I confeſs, this Reaſon is out of Doors; for being uncapable of Pleaſure, or Pain, they can have no Enjoyment. Upon this Account alſo, among others, I am leſs inclinable to that Opinion.

I ſhould now proceed to anſwer ſome Objections which might be made againſt the Wiſdom and Goodneſs of God in the Contrivance and Governance of the World, and all Creatures therein contained. But that is too great and difficult a Task for my Weakneſs, and would take up more Time than I have at preſent to ſpare, were I qualified for it; and beſides, ſwell this Volume to too great a Bulk. Only I ſhall ſay ſomething to one Particular, which was ſuggeſted to me by a Learned and Pious * Friend.

* Mr. *Rob. Burſcough* of *Totneſs*, in *Devon*.

Object. *A wiſe Agent acts for Ends. Now what End can there be of creating ſuch a vaſt Multitude of Inſects, as the World is fill'd with; moſt of which ſeems to be uſeleſs, and ſome alſo noxious and pernicious to Man, and other Creatures?*

Anſw. To this I ſhall Anſwer; 1. As to the Multitude of *Species*, or Kinds. 2. As to the Number of *Individuals* in each Kind.

Firſt, As to the Multitude of *Species*, (which we muſt needs acknowledge to be exceeding great, they being not fewer, perchance more than Twenty Thouſand.) I Anſwer, there were ſo many made,

1. To manifeſt and diſplay the Riches of the Power and Wiſdom of God, *Pſalm* civ. 24. *The Earth is full of thy Riches; ſo is this great and wide Sea; wherein are Things creeping innumerable*, &c. We ſhould be apt to think too meanly of thoſe Attributes of our Creator, ſhould we be able to come to an End of all his Works, even in this Sublunary World. And therefore, I believe, never any Man yet did, never any Man ſhall, ſo long as the World endures, by his utmoſt Induſtry, attain to the Knowledge of all the *Species* of Nature. Hitherto we have been ſo far from it, that in Vegetables, the Number of thoſe which have been diſcovered this laſt Age, hath far exceeded that of all thoſe which were known before. So true is that we quoted before out of *Seneca*, *Puſilla res eſt mundus, niſi in eo quod quærat omnis, mundus habeat.* The World is ſo richly furniſhed and provided, that Man need not fear Want of Employment, ſhould he live to the Age of *Methuſelah*, or ten Times as long. But of this, having touched it already, I ſhall add no more.

2. Another Reaſon why ſo many Kinds of Creatures were made, might be to exerciſe the contemplative Faculty of Man; which is in nothing ſo much pleas'd, as in Variety of Objects. We ſoon grow weary of one Study; and if all the Objects of the World could be comprehended by us, we ſhould, with *Alexander*,

ander, think the World too little for us, and grow weary of running in a Round of ſeeing the ſame Things. New Objects afford us great Delight, eſpecially if found out by our own Induſtry. I remember *Cluſius* ſaith of himſelf, " That upon the Diſcovery of a new " Plant, he did not leſs rejoice, than if he had " found a rich Treaſure." Thus God is pleaſed, by reſerving Things to be found out by our Pains and Induſtry, to provide us Employment moſt delightful and agreable to our Natures and Inclinations.

3. Many of theſe Creatures may be uſeful to us, whoſe Uſes are not yet diſcovered, but reſerved for the Generations to come, as the Uſes of ſome we now know are but of late Invention, and were unknown to our Forefathers. And this muſt needs be ſo, becauſe, as I ſaid before, the World is too great for any Man, or Generation of Men, by his, or their utmoſt Endeavours, to diſcover and find out all its Store and Furniture, all its Riches and Treaſures.

Secondly, As to the Multitude of Individuals in each Kind of *Inſect*. I Anſwer,

1. It is deſigned to ſecure the Continuance and Perpetuity of the ſeveral Species; which, if they did not multiply exceedingly, ſcarce any of them could eſcape the Ravine of ſo many Enemies as continually aſſault and prey upon them, but would endanger to be quite deſtroyed and loſt out of the World.

2. This vaſt Multitude of Inſects is uſeful to Mankind, if not immediately, yet mediately. It cannot be denied, that Birds are of great Uſe to us; their Fleſh affording us a good Part of our Food, and that the moſt delicate too, and their other Parts Phyſick, not excepting their very Excrements. Their Feathers ſerve to ſtuff our Beds and Pillows, yielding us ſoft and warm Lodging, which is no ſmall Convenience and Comfort to us, eſpecially in theſe Northern Parts of the World. Some of them have alſo been always employed by Military Men in Plumes, to adorn their Creſts, and render them formidable to their Enemies. Their Wings and Quils are made uſe of for Writing-Pens, and to bruſh and cleanſe our Rooms, and their Furniture. Beſides, by their melodious Accents they gratify our Ears; by their beautiful Shapes and Colours, they delight our Eyes, being very ornamental to the World, and rendring the Country where the Hedges and Woods are full of them, very pleaſant and chearly, which without them would be no leſs lonely and melancholy. Not to mention the Exerciſe, Diverſion, and Recreation, which ſome of them give us.

Now Inſects ſupply Land-Birds the chiefeſt Part of their Suſtenance: Some, as the entire *Genus* of *Swallows*, living wholly upon them, as I could eaſily make out, did any Man deny or doubt of it: And not *Swallows* alone, but alſo *Wood-peckers*, if not wholly, yet chiefly; and all other Sorts of Birds partly, eſpecially ly in Winter-time, when Inſects are their main Support, as appears by diſſecting their Stomachs.

As for young Birds, which are brought up in the Neſt by the old, they are fed chiefly, if not ſolely, by Inſects. And therefore for the Time when Birds for the moſt part breed in the Spring, when there are Multitudes of Caterpillars to be found on all Trees and Hedges. Moreover, it is very remakable, that of many ſuch Birds, as when grown up, feed almoſt wholly upon Grain, the young ones are nouriſhed by Inſects. For Example, *Pheaſants* and *Partridges*, which are well known to be granivorous Birds, the Young live only, or moſtly upon Ants Eggs. Now Birds, being of a hot Nature, are very voracious Creatures, and eat abundantly, and therefore there had need be an infinite Number of Inſects produced for their Suſtenance. Neither do Birds alone, but many Sorts of Fiſhes, feed upon Inſects, as is well known to Anglers, who bait their Hooks with them. Nay, which is more ſtrange, divers Quadrupeds feed upon Inſects, and ſome live wholly upon them, as two Sorts of *Tamunduus* upon Ants, which therefore are called in *Engliſh* Ant-Bears; the *Camelion* upon Flies; the Mole upon Earth-Worms: The *Badger* alſo lives chiefly upon Beetles, Worms, and other Inſects.

Here we may take Notice by the Way, That becauſe ſo many Creatures live upon Ants and their Eggs, Providence hath ſo ordered it, that they ſhould be the moſt numerous of any Tribe of Inſects that we know.

Conformable to this Particular, is the Reaſon my ingenious and inquiſitive Friend Mr. *Derham*, before remembred, hath given of the Production of ſuch innumerable Multitudes of ſome Aquatick Inſects.

I have often thought, (*ſaith he*) that there was ſome more than ordinary Uſe in the Creation for ſuch Inſects as are vaſtly numerous; ſuch as the *Pulices Aquatici*, which are in ſuch Swarms, as to diſcolour the Waters, and many others: And therefore I have bent my Enquiries to find out the Uſes of ſuch Creatures; wherein I have ſo far ſucceeded, as to diſcover, that thoſe vaſtly ſmall *Animalcula*, not to be ſeen without a Microſcope, with which the Waters are replete, ſerve for Food to ſome others of the ſmall Inſects of the Water, particularly to the *Nympha Culicaria* [*Hirſuta* it may be called] figured in *Swammerdam*. For viewing that *Nympha* one Day, to obſerve the Motion of its Mouth, and for what Purpoſe it is in ſuch continual Motion; whether as Fiſh to get Air, or to ſuck in Food, or both, I could plainly perceive the Creature to ſuck in many of theſe moſt minute *Animalcula*, that were ſwimming briskly about in the Water. Neither yet do theſe Animalcules ſerve only for Food to ſuch *Nymphæ*, but alſo to another to me anonymous Inſect of the Waters, of a dark Colour, cleft as it were in ſunder, and ſcarce ſo big as the ſmalleſt Pin's Head. Theſe

Inſects hunt theſe *Animalcules*, and other ſmall Creatures that occur in the Water, and devour them: And I am apt to think, although I have not yet ſeen it, that the *Pulex aquaticus arboreſcens* liveth upon theſe, or more minute and tender Animalcules, and that it is to catch them that it ſo leaps in the Water.

This to me ſeems a wonderful Work of God, to provide for the minuteſt Creatures of the Waters Food proper for them, that is, minute and tender, and fit for their Organs of Swallowing.

As for noxious Inſects, why there ſhould be ſo many of them produced, if it be demanded,

I anſwer, 1. That many that are noxious to us, are ſalutary to other Creatures; and ſome that are Poiſon to us, are Food to them. So we ſee the Poultry-kind feed upon *Spiders* Nay, there is ſcarce any noxious Inſect, but one Bird or other eats it, either for Food or Phyſick. For many, nay, moſt of thoſe Creatures, whoſe Bite, or Sting, is poiſonous, may ſafely be taken entire into the Stomach. And therefore it is no wonder, that not only the *Ibis* of *Egypt*, but even *Storks* and *Peacocks* prey upon and deſtroy all Sorts of *Serpents*, as well as *Locuſts* and *Caterpillars*.

2. Some of the moſt venomous and pernicious of Inſects afford us noble Medicines, as *Scorpions*, *Spiders*, and *Cantharides*.

3. Theſe Inſects ſeldom make uſe of their offenſive Weapons, unleſs aſſaulted or pro-

voked in their own Defence, or to revenge an Injury. Let them but alone, and annoy them not, nor diſturb their Young, and unleſs accidentally, you ſhall ſeldom ſuffer by them.

Laſtly, God is pleaſed ſometimes to make uſe of them as Scourges, to chaſtize or puniſh wicked Perſons, or Nations, as he did *Herod* and the *Egyptians*. No Creature ſo mean and contemptible, but God can, when he pleaſes, produce ſuch Armies of them, as no humane Force is able to conquer, or deſtroy; but they ſhall of a ſudden conſume and devour up all the Fruits of the Earth, and whatever might ſerve for the Suſtenance of Man, as *Locuſts* have often been obſerved to do.

Did theſe Creatures ſerve for no other Uſe, as they do many; yet thoſe that make them an Objection againſt the Wiſdom of God, may (as Dr. *Cockburn* well notes) as well upbraid the Prudence and Policy of a State for keeping Forces, which generally are made up of very rude and inſolent People, which yet are neceſſary, either to ſuppreſs Rebellions, or puniſh Rebels, and other diſorderly and vicious Perſons, and keep the World in quiet.

From that Part of this Diſcourſe which relates to the Body of Man, I ſhall make theſe Practical Inferences.

Infer. 1. Firſt, Let us give Thanks to Almighty God for the Perfection and Integrity ty of our Bodies. It would not be amiſs to put it into the Euchariſtical Part of our daily Devotions: We praiſe Thee, O God, for the due Number, Shape, and Uſe of our Limbs and Senſes; and in general, of all the Parts of our Bodies; we bleſs thee for the ſound and healthful Conſtitution of them, Pſal. x. *It is thou that haſt made us, and not we ourſelves; in thy Book were all our Members written.* The Formation of the Body is the Work of God, and the whole Proceſs thereof attributed to him, *Pſal.* cxxix. 13, 14, 15. The Mother that bears the Child in her Womb, is not conſcious to any Thing that is done there; ſhe underſtands no more how the Infant is formed, than itſelf doth. But if God hath beſtowed upon us any peculiar Gift, or Endowment, wherein we excel others, as Strength, or Beauty, or Activity, we ought to give him ſpecial Thanks for it; but not to think the better of ourſelves therefore, or deſpiſe them that want it.

Now, becauſe theſe bodily Perfections, being common Bleſſings, we are apt not at all to conſider them, or not to ſet a juſt Value on them; and becauſe the Worth of Things is beſt diſcerned by their Want, it would be uſeful ſometimes to imagine, or ſuppoſe ourſelves, by ſome Accident, to be deprived of one of our Limbs, or Senſes, as a Hand, or a Foot, or an Eye; for then we cannot but be ſenſible, that we ſhould be in worſe Condition than now we are, and that we ſhould ſoon find a Difference between two Hands and one Hand, two Eyes and one Eye, and that two excel one as much in Worth as they do in Number; and yet, if we could ſpare the Uſe of the loſt Part, the Deformity and Unſightlineſs of ſuch a Defect in the Body, would alone be very grievous to us. Again, which is leſs, ſuppoſe we only, that our Bodies want of their juſt Magnitude; or that they, or any of our Members are crooked or diſtorted, or diſproportionate to the reſt, either in Exceſs or Defect; nay, which is leaſt of all, that the due Motion of any one Part be perverted, as, but of the Eyes in Squinting, the Eye-Lids in Twinkling, the Tongue in Stammering, theſe Things are ſuch Blemiſhes and Offences to us, by making us Gazing-Stocks to others, and Objects of their Scorn or Deriſion, that we could be content to part with a good Part of our Eſtates to repair ſuch Defects, or heal ſuch Infirmities. Theſe Things conſidered, and duly weighed, would ſurely be a great and effectual Motive to excite in us Gratitude for this Integrity of our Bodies, and to eſteem it no ſmall Bleſſing, I ſay, a Bleſſing and Favour of God to us; for ſome there be that want it, and why might not we have been of that Number? God was no way obliged to beſtow it upon us.

And as we are to give Thanks for the Integrity of our Body, ſo are we likewiſe for the Health of it, and the ſound Temper and Conſtitution of all its Parts and Humours; Health being the principal Bleſſing of this Life, without which we cannot enjoy, or take Comfort in any Thing beſides.

Neither are we to give Thanks alone for the firſt Collation of theſe Benefits, but alſo for their Preſervation and Continuance. God preſerves our Souls in Life, and defends us from Dangers and ſad Accidents, which do ſo beſet us on every Side, that the greateſt Circumſpection in the World could not ſecure us, did not his good Providence continually watch over us. We may be ſaid to walk and converſe in the midſt of Snares; beſides, did we but duly conſider the Make and Frame of our Bodies, what a Multitude of minute Parts and Veſſels there are in them, and how an Obſtruction in one, redounds to the Prejudice of the Whole, we could not but wonder how ſo curious an Engine as Man's Body could be kept in Tune one Hour, as we uſe it, much leſs hold out ſo many Years? How it were poſſible it ſhould endure ſuch Hardſhips, ſuch Blows, ſo many Shocks and Concuſſions, nay, ſuch Violences and Outrages as are offered it by our frequent Exceſſes, and not be diſordered and rendered Uſeleſs; and acknowledge the tranſcendent Art and Skill of him who ſo put it together, as to render it thus firm and durable.

Infer. 2. Secondly, Have a care thou doſt not by any vicious Practice deface, marr, or deſtroy the Workmanſhip of God. So uſe this Body as to preſerve the Form and Comelineſs, the Health and Vigour of it.

1. For the Form and Beauty of the Body, which Mankind generally is fond enough of; and which muſt be acknowledged to be a Natural Endowment and Bleſſing of God, a Thing deſirable, which all Men take Complacency in; which renders Perſons gracious and acceptable in the Eyes of others; of which yet we do not obſerve, That brute Beaſts take any Notice at all: Of this I ſhall obſerve, That outward Beauty is a Sign of inward; and that handſome Perſons are naturally well inclined, till they do either debauch themſelves, or are corrupted by others; and then with their Manners they marr their Beauty too. For a Man may obſerve, and eaſily diſcern, that as Perſons are better or worſe inclined, the very Air of their Viſage will alter much; and that vicious Courſes, *defacing the inward Pulchritude of the Soul, do change even the outward Countenance into an abhorr'd Hue* *: As is evident in the Vices of Intemperance and Anger, and may, by ſagacious Perſons, be obſerved in others alſo. No better Coſmeticks than a ſevere

* Dr. *More.*

ſevere Temperance and Purity, a real and unaffected Modeſty and Humility, a gracious Temper and Calmneſs of Spirit, a ſincere and univerſal Charity. No true Beauty without the Signatures of theſe Graces in the very Countenance. They, therefore, who through the contrary Vices do deface and blot out this natural Character and Impreſs, and do Violence to their own Inclinations, that ſacrifice this Jewel to their Luſts, that reject this Gift of God, and undervalue the Favour of Man, aggravate their Sin and Miſery, and purchaſe Hell at ſomewhat a dearer Rate than others do. And thoſe that have but a mean Portion of this Gift, are the more obliged by virtuous Practices, not only to preſerve, but to improve it. Virtue, (as *Cicero* obſerves) if it could be ſeen with Corporeal Eyes, *admirabiles ſui Amores excitaret*; *it would excite a wonderful Love of itſelf.* By the Signatures it there impreſſes, it is in ſome Meaſure viſible in the Faces of thoſe that practiſe it, and ſo muſt needs impart a Beauty and Amiableneſs to them.

Diogenes Laertius, in the Life of *Socrates*, tells us, That that Philoſopher was wont to adviſe young Men, συνεχὲς κατοπτρίζεσθαι, often to behold themſelves in their Looking-Glaſſes or Mirrors. Grammercy, *Socrates*, that is good Council indeed! Will our young Gentlemen and Ladies be ready to ſay, We like it very well, and we practiſe accordingly? And it ſeems we are injuriouſly taxed and reprehended by Divines, for ſpending ſo much Time between a Comb and a Glaſs. Be not over-haſty; take what remains along with you: Mark the End for which the Philoſopher exhorts this, Ἵν' εἰ μὲν καλοὶ εἶεν, ἄξιοι γίγνοιντο, εἰ δ' αἰσχροὶ παιδείᾳ τῆν δυσείδειαν ἐπικαλύπτοιεν, *That if they be handſome, they might approve themſelves worthy of their Form; but if they be otherwiſe, they may by Diſcipline and Inſtitution hide their Deformity*, And ſo by their virtuous Behaviour compenſate the Hardneſs of their Favour, and by the Pulchritude of their Souls, make up what is wanting in the Beauty of their Bodies. And truly, I believe, a virtuous Soul hath Influence upon its Vehicle, and adds a Luſtre even to the outward Man, ſhining forth in the very Face.

2. So uſe the Body, as to preſerve the Health and Vigour, and conſequently produce the Life of it. Theſe are Things that all Men covet. No more effectual Means for the Maintenance and Preſervation of them, than a regular and virtuous Life. That Health is impaired by Vice, daily Experience ſufficiently evinceth. I need not ſpend Time to prove, what no Man doth or can deny. And as for Length of Days, we find by the ſame Experience, that intemperate and diſorderly Perſons are, for the moſt part, ſhort-liv'd: Moreover, immoderate Cares and Anxiety are ob-

ſerved ſuddenly to bring gray Hairs upon Men, which are uſually the Signs and Forerunners of Death. And, therefore, the way to live long, muſt needs be in all Points to uſe our Bodies, ſo as is moſt agreable to the Rules of Temperance, and Purity, and right Reaſon. Every Violence offered to it, weakens and impairs it, and renders it leſs durable and laſting. One Means there is, which Phyſicians take Notice of, as very effectual for the Preſervation of Health, which I cannot here omit, that is, a quiet and chearful Mind, not afflicted with violent Paſſions, or diſtracted with immoderate Cares; for theſe have a great and ill Influence upon the Body. Now, how a Man can have a quiet and chearful Mind under a great Burthen and Load of Guilt, I know not, unleſs he be very Ignorant, or have a ſeared Conſcience. It concerns us, therefore, even upon this Account, to be careful of our Converſations, and to keep our Conſciences void of Offence, both toward God, and toward Men.

Infer. 3. Thirdly, Did God make the Body? Let him have the Service of it, *Rom.* xii. 1. *I beſeech you, Brethren, by the Mercies of God, that you preſent your Bodies a living Sacrifice, Holy, acceptable unto God, which is your reaſonable Service.* How we ſhould do that, St. *Chryſoſtom* tells us in his Commentary upon this Place, Μηδὲν ὀφθαλμος πὸνηρὸν βλεπέτω;

καὶ γέγονε θυσία· μηδὲν ἡ γλῶσσα λαλέιτω αἰσχρὸν, καὶ γέγονε προσφορά· μηδὲν ἡ χεὶρ πραττέτω παράνομον, καὶ γέγονεν ὁλοκαύτωμα, &c. *Let the Eye behold no evil thing, and it is made a Sacrifice; let the Tongue ſpeak no filthy Word, and it becomes an Oblation: Let the Hand do no unlawful Action, and you render it a Holocauſt. Yet it is not enough thus to reſtrain them from Evil; but they muſt alſo be employed and exerciſed in doing that which is good: The Hand in giving Alms, the Tongue in bleſſing them that curſe us and diſpitefully uſe us, the Ear in hearkening to divine Lectures and Diſcourſes,* 1 Cor. vi. 20. *Glorify God in your Body, or with your Body, and in your Spirit, which are God's;* and that not by Redemption only, of which the Apoſtle there ſpeaks, but by Creation alſo. *Rom.* vi. 13. *Neither yield ye your Members as Inſtruments of Unrighteouſneſs unto Sin, but as Inſtruments of Righteouſneſs unto God.* And again, *ver.* 19. *Even ſo now yield your Members Servants of Righteouſneſs unto Holineſs.* I ſhall Inſtance in two Members, which are eſpecially to be guarded and reſtrained from Evil, and employed in the Service of God.

Firſt, The *Eye*. We muſt *turn away our Eyes from beholding Vanity*, as *David* prayed God would his, *Pſal.* cxix. 37. We muſt *make a Covenant with our Eyes*, as *Job* did, *Job* xxxi. 1. Theſe are the Windows that let in exteriour Objects to the Soul: By theſe the

Heart is affected; this way Sin entred firſt into the World. Our firſt Parent ſaw, that *the Tree* and its Fruit *was pleaſant to the Eyes*, and ſo was invited to take and eat it. There are four Sins eſpecially for which the Eye is noted, as either diſcovering themſelves in the Eyes, or whoſe Temptations enter in by, and ſo give Denomination to the Eye.

1. There is a *proud Eye*, Prov. xxx. 13. *There is a Generation, O how lofty are their Eyes! And their Eye-lids are lifted up*, Chap. vi. 17. *A proud Look* is reckoned the firſt of thoſe ſix Things that God hates, *Pſal.* xviii. 27. *God* (the *Pſalmiſt* ſaith) *will bring down proud or high Looks*; Pſal. ci. 5. *Him that hath a high Look and a proud Heart* (ſaith *David*) *I will not ſuffer.* And in *Pſal.* cxxxi. 1. he ſaith of himſelf, that *his Heart is not haughty, nor his Eyes lofty.* By which Places it appeareth, that Pride ſheweth forth itſelf in the Eyes eſpecially, and that they are, as it were, the Seat or Throne of it.

2. There is a *wanton* Eye, which the Prophet *Iſaiah* ſpeaks of in his third Chapter, at the 16th Verſe, *Becauſe the Daughters of* Jeruſalem *walk with ſtretched-out Necks, and wanton Eyes.* The Apoſtle *Peter*, in his Second Epiſtle, ii. 24. mentions *Eyes full of Adultery.* For by theſe Caſements enter in ſuch Objects, as

may provoke and ſtir up adulterous Thoughts in the Mind, as they did in *David's*; and likewiſe impure Thoughts conceived in the Heart, may diſcover themſelves by the Motions of the Eye. And, therefore, in this reſpect we ſhould do well, with holy *Job*, to make a Covenant with our Eyes, not to gaze upon any Object which may tempt us to any inordinate Appetite or Deſire. For our Saviour tells us, it were better to pluck out our right Eye, than that it ſhould be an Offence to us: Which I ſuppoſe refers to this Matter, becauſe it immediately follows thoſe Words, *He that looketh upon a Woman to luſt after her, hath already committed Adultery with her in his Heart.*

3. There is a *covetous Eye.* By Covetouſneſs, I underſtand, not only a Deſiring what is another Man's, which is forbidden in the Tenth Commandment, but alſo an inordinate Deſire of Riches, which the Apoſtle *John* ſeems to underſtand in his Firſt Epiſtle, ii. 16. *by the Luſt of the Eye.* And Covetouſneſs may well be called the *Luſt of the Eye,* becauſe, 1. The Temptation or tempting Object enters by the Eye. So the Seeing the Wedge of Gold and *Babyloniſh* Garment ſtirred up the covetous Deſire in *Achan.* 2. Becauſe all the Fruit a Man reaps of Riches, more than will furniſh his Neceſſities and Conveniencies, is the Feeding of his Eye, or the Pleaſure he takes in

the beholding of them, *Eccleſ.* v. 11. *When Goods increaſe*, &c. *What Good is there to the Owners thereof, ſaving the Beholding them with their Eyes?*

4. There is an *envious* Eye, which, by our Saviour, is called an evil Eye, *Matth.* xx. 15. *Is thine Eye evil becauſe I am good?* That is, envieſt thou thy Brother, becauſe I am kind to him? And, vii. 22. one of thoſe evil Things which proceed out of the Heart, and defile a Man, is *an evil Eye*. Envy is a Repining at the Proſperity or Good of another, or Anger and Diſpleaſure at any Good of another which we want or any Advantage another hath above us. As in the Parable of the Labourers in the Vineyard, thoſe that came in firſt envied the laſt, not becauſe they received more than they, but becauſe they received equal Wages for leſs Time. Thoſe that are ſubject to this Vice, cannot endure to ſee another Man thrive; and are apt to think his Condition better than theirs, when indeed it is not.

Let us then ſo govern our Eyes, that we diſcover by them none of theſe Vices. Let the Humility and Purity of our Minds appear even in our outward Looks. Let neither Pride nor Luſt manifeſt themſelves in the Poſture or Motions of our Eyes. Let us have a care, that theſe Members be neither the Inlets nor Outlets of any of the fore-mentioned Vices; that they neither give Admiſſion to the Temptation, nor be expreſſive of the Conception of them. Let us employ them in reading the Word of God, and other Books, for the Increaſe of our Knowledge, and Direction of our Practice; in diligently viewing and contemplating the Works of the Creation, that we may diſcern and admire the Footſteps of the Divine Wiſdom, eaſily to be traced in the Formation, Diſpoſition, and Deſignations of them. Let us take notice of any extraordinary Events and Effects of God's Providence towards ourſelves or others, Perſonal or National: That as they are the Iſſues of his Mercy or Juſtice, they may ſtir up ſuitable Affections in us of Thankfulneſs or Fear. Let thoſe ſad and miſerable Objects, that preſent themſelves to our Sight, move us to pity and Commiſeration: And let our Eyes ſometimes be exerciſed in Weeping for the Miſeries and Calamities of others, but eſpecially for our own and their Sins.

Secondly, Another Member I ſhall mention is the *Tongue*, which as it is the chief Inſtrumen of Speech, ſo it may be well or ill employed in the Exerciſe of that Action, and therefore ſtands in need of Direction and Reſtraint. I remember I once heard from an ingenious *Anatomiſt* of *Padua* this Obſervation, That there are but two Members in the Body that have a natural Bridle, both which do very much need it; the Tongue, and another I ſhall not name. The Signification whereof may be, that they are not to be let looſe, but diligently curbed and held in. That the Tongue needs a Bridle, you will readily grant, if you read what the Apoſtle *James* hath written of it, *Chap.* iii. 6. *The Tongue is a Fire, a World of Iniquity: So is the Tongue among our Members, that it defileth the whole Body, and ſetteth on fire the Courſe of Nature, and is ſet on Fire of Hell. For every Kind of Beaſts, and of Birds, and of Serpents, and of Things in the Sea, is tamed, and hath been tamed of Mankind; but the Tongue can no Man tame; it is an unruly Evil, full of deadly Poiſon.* For the better Government of the Tongue, I ſhall note ſome Vices of Speech, which muſt carefully be avoided. Firſt of all, *Loquacity*, or *Garrulity.* This the Contrivance of our Mouths ſuggeſts to us. Our Tongues are fenced and guarded with a double Wall or Mound of Lips and Teeth, that our Words might not raſhly and unadviſedly ſlip out. Then Nature hath furniſhed us with two Ears, and but one Tongue, to intimate, that we muſt hear twice ſo much as we ſpeak. Why *Loquacity* is to be avoided, the Wiſe Man gives us a ſufficient Reaſon, *Prov.* x. 19. *In the Multitude of Words there wanteth not Sin.* And, *Eccleſ.* v. 7. *In many Words there are divers Vanities.* To which we may add another, of great Force with moſt Men, *viz.* That it hath been always eſteemed an Effect and Argument of Folly, *Eccleſ.* v. 3. *A Fool's Voice is known by multitude*

tude of Words. And, on the contrary, to be of few Words, is a Sign of Wiſdom; and he that is wiſe enough to be ſilent, though a Fool, may paſs undiſcover'd. Beſides all this, a talkative Perſon muſt needs be impertinent, and ſpeak many idle Words, and ſo render himſelf burthenſome and odious to Company; and may perchance run himſelf upon great Inconveniences, by blabbing out his own, or others Secrets; for a Word once utter'd, *fugit irrevocabile*, is irrevocable, whatever the Conſequence of it be. Great need, therefore, have we *to ſet a Watch over our Mouths, and to keep the Door of our Lips*, Pſal. cxli. 3. and not ſuffer our Tongues * προτρέχειν τῆς διανοίας as *Iſocrates* phraſeth it.

* *Run before the Underſtanding, or Wit.*

Secondly, Lying, or falſe Speaking. There is difference between *Mentiri* and *Mendacium dicere*, that is, Lying, and ſpeaking of an Untruth, or Thing that is falſe. *Mentiri*, is *contra mentem ire*, which, though it be no good Etymology of the Word, is a good Notion of the Thing; that is, to go againſt one's Mind, or ſpeak what one does not think.

Ἕτερον μὲν κεύθειν ἐνὶ φρεσὶν, ἄλλο δὲ βάζειν.

As *Homer* expreſſes it, to conceal one Thing in the Mind, and ſpeak another with the Tongue. Hence a Man may ſpeak an Untruth,

truth, and yet not lye, when he thinks he ſpeaks the Truth; and, on the contrary, may ſpeak what is materially true, and yet lye, when he ſpeaks what he thinks not to be true. The Tongue was made to be the *Index* of the Mind, Speech the Interpreter of Thought; therefore there ought to be a perfect Harmony and Agreement between theſe two. So that Lying is a great Abuſe of Speech, and a perverting the very End of it, which was to communicate our Thoughts one to another. It hath alſo an ill Principle, for the moſt Part, proceeding either from *Baſeneſs of Spirit, or Cowardice,* as in them that have committed a Fault, and deny it, for Fear of Puniſhment, or Rebuke: And, therefore, the ancient *Perſians*, as Xenophon tells us in his Κύρȣ παιδεία, made it one of the three Things they diligently taught their Children; which were ἱππεύειν, καὶ τοξεύειν, καὶ ἀληθιύειν· *to Ride, to Shoot,* and *to ſpeak the Truth:* Or from *Covetouſneſs,* as in Tradeſmen, who falſly commend their Commodities, that they may vend them for a greater Price; or from *Vanity* and *vain Glory,* in them who falſly boaſt of any Quality or Action of their own. It is odious both to God and Man. To God, *Prov.* vi. 17. *A lying Tongue* is one of thoſe ſix or ſeven Things that are an *Abomination to Him.* To Men, as *Homer* witneſſeth in the Verſe preceeding the forequoted.

Ἐχθρὸς γάρ μοι κεῖνος ὅμως Αΐδαο πύλησι, &c.

He that tells Lyes is as hateful to me, as the Gates of Hell, or Death. ------ The Practice of Lying is a Diabolical Exerciſe, and they that uſe it are the Devil's Children, as our Saviour tells us, *John* viii. 44. *Ye are of your Father the Devil*, &c. *for he is a Lyar, and the Father of it.* And, laſtly, it is a Sin that excludes out of Heaven, and depreſſes the Soul into Hell, *Rev.* xxi. 8. *All Lyars ſhall have their Part in the Lake which burns with Fire and Brimſtone, which is the ſecond Death.*

Thirdly, Another Vice, or Abuſe of Speech, or vicious Action, to which the Tongue is Inſtrumental, is *Slandering*; that is, raiſing a falſe Report of any Man tending to his Defamation. This might have been comprehended under the former Head, being but a Kind of Lying proceeding from Enmity, or Ill-Will. It is a very great Injury to our Neighbour; Mens Reputation being as dear to them as Life itſelf: So that it is grown to be a Proverb among the Vulgar, *Take away my good Name, and take away my Life.* And that which enhanſes this Injury is, that it is irreparable. We cannot, by any contrary Declaration, ſo clear the Innocency of our Neighbour, as wholly to extirpate the preconceived Opinion out of the Minds of thoſe to whom our Confeſſion comes; and many will remain whom the Calumny hath reach'd, to whom the Vindication probably will not extend; the Pravity of Man's Nature being more apt to ſpread and divulge an ill Report, than to ſtop and ſilence it. I might inſtance in flattering of others, and boaſting of ourſelves for two Abuſes of Speech; but they may both be referred to Lying, the one to pleaſe others, and puff them up with Self-Conceit, and a falſe Opinion, that they have ſome excellent Quality, or Endowment, which they want, or have not in ſuch a Degree, or that they are better thought of by others, than indeed they are, and more honour'd: The other, to gain more Honour than is due to ourſelves. Neither yet is it boaſting only of what we have not, but alſo what we have, condemned and diſallowed by God and Men, as being contrary to that Humility and Modeſty that ought to be in us, *Prov.* xxvii. 2. *Let another Man praiſe thee, and not thine own Mouth; a Stranger, and not thine own Lips.* And Moraliſts proceed ſo far as to cenſure all unneceſſary περιαυτολογία, that is talking of a Man's ſelf.

Fourthly, Obſcene and *impure Words* are another vicious Effect of the Tongue. Thoſe are principally the σαπροὶ λόγοι, rotten Speeches the Apoſtle ſpeaks of, *Eph.* v. 29. Such as chaſt Ears abhor, which tend only to the depraving and corrupting the Hearers; and are to be ſtudiouſly and carefully avoided by all that pretend to Chriſtianity, *Eph.* v. 3. *But Fornication, and all Uncleanneſs, let it not be once named among you.*

Fifthly, Curſing, and railing, or reviling Words, are alſo a great Abuſe of Speech, and outrageous Effects and Expreſſions of Malice and Wickedneſs, *Pſal.* x. 7. The *Pſalmiſt* makes it Part of the Character of a wicked Man, That *his Mouth is full of Curſing*. Which Paſſage we have quoted by the Apoſtle, *Rom.* iii. 14. *Whoſe Mouth is full of Curſing and Bitterneſs.*

Sixthly, Swearing, and irreverently uſing the Name of God in common Diſcourſe and Converſe, is another Abuſe of the Tongue; to which I might add vehement Aſſeverations upon ſlight and trivial Occaſions. I do not deny, but in a Matter of Weight and Moment, which will bear out ſuch Atteſtation, and where Belief will not be obtained without them, and yet it may much import the Hearer, or Speaker, that his Words be believed, or where the Hearer would not otherwiſe think the Matter ſo momentous, or important, as indeed it is, Proteſtations and Aſſeverations, yea, Oaths, may lawfully be uſed. But to call God to witneſs to an Untruth, or a Lye, perhaps, or to appeal to Him on every trivial Occaſion, in common Diſcourſe, cuſtomarily, without any

Conſideration of what we ſay, is one of the higheſt Indignities and Affronts that can be offer'd him, being a Sin to which there is no Temptation: For it is ſo far from gaining Belief, (which is the only Thing that can with any Shew of Reaſon be pleaded for it) that it rather creates Diffidence and Diſtruſt. For as *multa fidem promiſſa levant*, ſo *multa Juramenta* too; it being become a Proverb, *He that will Swear, will Lye.* And good Reaſon there is for it; for he that ſcruples not the Breach of one of God's Commands, is not likely to make Conſcience of the Violation of another.

Laſtly, (for I will name no more) Scurrilous Words, Scoffing, and Jeering, Flouting, and Taunting, are to be cenſured as vicious Abuſes of Speech.

This Scoffing and Deriſion proceeds from Contempt, and that of all Injuries Men do moſt impatiently bear; nothing offends more, or wounds deeper: And, therefore, what greater Violation of that general Rule of Chriſtian Practice, *to do to others as we would they ſhould do unto us?* This Injury of being derided, the *Pſalmiſt* himſelf complains of, *Pſal.* lxix. 11, 12. *I became a Proverb to them. They that ſit in the Gate, ſpeak againſt me, and I was the Song of the Drunkards.* And, *Pſal.* xxxv. 15. according to the Church-Tranſlation, *The very Abjects came together againſt me unawares, making Mows at me, and ceaſed not;*

not; and the Prophet *Jeremy*, Jer. xx. 7. *I am in Deriſion daily, every one mocketh me.* And though there may be ſome Wit ſhewn in Scoffing and Jeſting upon others, yet is it a Practice inconſiſtent with true Wiſdom. The Scorner, and the Wiſe Man, are frequently oppoſed in Scripture, *Prov.* ix. 8. and *Chap.* xiii. 1, *&c.* It is a Proverbial Saying, *The greateſt Clerks are not always the wiſeſt Men.* I think the Saying might as often be verified of the greateſt *Wits.* Scorning, in that Gradation in the firſt *Pſalm*, is ſet down as the higheſt Step of Wickedneſs. And *Solomon* tells us, *That Judgments are prepared for the Scorners.*

You will ſay to me, How then muſt our Tongues be employed? I anſwer, 1. In Praiſes and Thankſgiving unto God, *Pſal.* xxxv. 28. *And my Tongue ſhall ſpeak of thy Righteouſneſs, and of thy Praiſes, all the Day long.* Parallel whereto, is *ver.* 24. of *Pſal.* lxxi. Indeed, the Book of *Pſalms* is, in a great Meaſure, but an Exerciſe of, or Exhortation to, this Duty. 2. We muſt exerciſe our Tongues in talking of all his wondrous Works; *Pſal.* cxlv. 5, 6. *I will ſpeak of the glorious Honour of thy Majeſty, and of thy wondrous Works.* 3. In Prayer to God. 4. In Confeſſion of Him, and his Religion, and publickly owning it before Men, whatever the Hazard be. 5. In Teaching, Inſtructing, and Counſelling of others. 6. In Exhorting them. 7. In Comforting them that need it. 8. In Reproving them. All which Particulars I might enlarge upon; but becauſe they come in here only as they refer to the Tongue, it may ſuffice to have mentioned them ſummarily.

Thirdly, Let us hence learn duly to prize and value our Souls. Is the Body ſuch a rare Piece, what then is the Soul? The Body is but the Husk or Shell, the Soul is the Kernel; the Body is but the Cask, the Soul the precious Liquor contained in it; the Body is but the Cabinet, the Soul the Jewel; the Body is but the Ship or Veſſel, the Soul the Pilot; the Body is but the Tabernacle, and a poor Clay-Tabernacle or Cottage too, the Soul the Inhabitant; the Body is but the Machine or Engine, the Soul that ἐνδόν τι, that actuates and quickens it; the Body is but the dark Lantern, the Soul or Spirit is the Candle of the Lord that burns in it: And ſeeing there is ſuch Difference between the Soul and the Body in reſpect of Excellency, ſurely our better Part challenges our greateſt Care and Diligence to make Proviſion for it. Bodily Proviſion is but half Proviſion, it is but for one Part of a Man, and that the meaner and more ignoble too, if we conſider only the Time of this Life; but if we conſider a future Eſtate of endleſs Duration after this Life, then Bodily Proviſion will appear to be, I do not ſay quarter Proviſion, but no Proviſion at all, in Compariſon; there being no Proportion between ſo ſhort a Period of Time, and the infinite Ages of Eternity. Let us not then be ſo fooliſh as to employ all our Thoughts, and beſtow all our Time and Pains about cheriſhing, accommodating and gratifying our Bodies, in *making Proviſion for the Fleſh to fulfil the Luſts thereof*, as the Apoſtle phraſeth it; and ſuffer our Souls to lie by neglected, in a miſerable, and poor, and blind, and naked Condition. Some Philoſophers will not allow the Body to be an eſſential Part of Man, but only the Veſſel or Vehicle of the Soul; *Anima cujuſque eſt quiſque: The Soul is the Man.* Though I would not be ſo unequal to it, yet I muſt needs acknowledge it to be but an inferiour Part: It is therefore ſo to be treated, ſo dieted and provided, as to render it moſt calm and compliant with the Soul, moſt tractable and obſequious to the Dictates of Reaſon; not ſo pampered and indulged, as to encourage it to caſt its Rider, and to take the Reins into its own Hand, and uſurp Dominion over the better Part, the τὸ ἡγεμονικὸν, to ſink and depreſs it into a ſordid Compliance with its own Luſts, *Atque affigere humi Divinæ particulam auræ.*

This is our Duty; but alas! what is our Practice? Our great Partiality towards our Bodies, and Neglect of our Souls, ſhews clearly which Part we prefer. We are careful enough of wounding or maiming our Bodies, but we make bold to laſh and wound our Souls daily; for every Sin we commit, being contrary to its Nature, is a real Stripe, yea, a mortal Wound to the Soul; and we ſhall find it to be ſo, if our Conſciences be once awakened to feel the Sting and Smart of it. We are induſtrious enough to preſerve our Bodies from Slavery and Thraldom, but we make nothing of ſuffering our Souls to be Slaves and Drudges to our Luſts, and to live in the vileſt Bondage to the moſt degenerate of Creatures, the Devil: We are thrifty and provident enough not to part with any Thing that may be ſerviceable to our Bodies under a good Conſideration, and we ſo eſteem them, as that we will part with all we have for the Life of them; but we make little Account of what is moſt beneficial to our Souls, the Means of Grace and Salvation, the Word of God, and Duties of his Worſhip and Service; nay, we can be content to ſell our Souls themſelves for a Trifle, for a Thing of nothing, yea, for what is worſe than nothing, the ſatisfying of an inordinate and unreaſonable Appetite or Paſſion. We highly eſteem and ſtand much upon our Nobility, our Birth and Breeding, though we derive nothing from our Anceſtors but our Bodies and Corporeal Qualities; and it is uſeful ſo far to value and improve this Advantage, as to provoke us to imitate the good Examples of our Progenitors, not to degenerate from them, nor to do any Thing unworthy of our Breeding; and yet the Divine

vine Original of our Souls, which are Beams from the Father of Light, and the immediate Offspring of God himſelf τοῦ γὰρ καὶ γένος ἐσμὲν, hath little Influence upon us to engage us to walk worthily of our Extraction, and to do nothing that is baſe or ignoble, and unſuitable to the Dignity of our Birth.

You will ſay, how ſhall we manifeſt our Care of our Souls? What ſhall we do for them? I anſwer, the ſame we do for our Bodies.

Firſt, we feed our Bodies, our Souls are alſo to be fed: The Food of the Soul is Knowledge, eſpecially Knowledge in the Things of God, and the Things that concern its eternal Peace and Happineſs; the Doctrine of Chriſtianity, the Word of God read and preached, 1 Pet. ii. 2. *As new born Babes deſire the ſincere Milk of the Word, that ye may grow thereby*, Heb. 5. 12. The Apoſtle ſpeaks both of Milk and of ſtrong Meat. Milk he there calls the Principles of the Doctrine of Chriſt: And again, 1 Cor. ii. 3. *I have fed you with Milk and not with Meat, for hitherto ye were not able to bear it.* So we ſee in the Apoſtle's Phraſe, Feeding of the Flock, is Teaching and inſtructing of them. Knowledge is the Foundation of Practice; it is impoſſible to do God's Will before we know it; the Word muſt be received into an honeſt and good Heart and underſtood, before any Fruit can be brought forth.

Secondly, We heal and cure our Bodies, when they are inwardly ſick, or outwardly harmed: Sin is the Sickneſs of the Soul, *Matth.* ix. 12. *They that be whole need not a Phyſician, but they that be ſick*, ſaith our Saviour by way of Similitude; which he explains in the next Verſe, *I am not come to call the Righteous, but Sinners to Repentance.* For the Cure of this Diſeaſe, an humble, ſerious, hearty Repentance, is the only Phyſick; not to expiate the Guilt of it, but to qualify us to partake of the Benefit of that Atonement which our Saviour Chriſt hath made, by the Sacrifice of Himſelf, and reſtore us to the Favour of God, which we had forfeited, it being as much as in us lies an Undoing again what we have done.

Thirdly, We cloath and adorn our Bodies; indeed too much Time and too many Thoughts we beſtow upon that; our Souls alſo are to be cloathed with holy and virtuous Habits, and adorned with good Works, 1 *Pet.* v. 5. *Be ye cloathed with Humility*: And in the ſame Epiſtle, *Chap.* ii. 2. he exhorts Women *to adorn themſelves, not with that outward adorning of plaiting the Hair, and wearing Gold*, &c. *but with the Ornament of a meek and quiet Spirit, which is in the Sight of God of great Price*:

And in Rev. xix. 8. *The Righteouſneſs of the Saints* is called *fine Linen.* And the Saints are ſaid to be cloathed in *white Raiment,* Matth. xxiii. 11. Works of Righteouſneſs, and a Converſation becoming the Goſpel, is called a *Wedding-Garment,* Coloſ. iii. 10. *Put on the new Man.* And again, *Put on therefore, as the Elect of God, Bowels of Mercy, Meekneſs,* &c. On the contrary, vicious Habits, and ſinful Actions, are compared to filthy Garments. So, *Zech.* iii. 3. *Joſhua* the High-Prieſt is ſaid to be *cloathed with filthy Garments;* which, in the next Verſe, are interpreted his Iniquities, either Perſonal, or of the People whom he repreſented; *I have cauſed thy Iniquity to paſs from thee, and will cloath thee with Change of Raiment.*

Fourthly, We arm and defend our Bodies; and our Souls have as much Need of Armour as they: For the Life of a Chriſtian is a continual Warfare; and we have potent and vigilant Enemies to encounter withal, the Devil, the World, and this corrupt Fleſh we carry about with us. We had need, therefore, to take to us the Chriſtian Panoply, to *put on the whole Armour of God, that we may withſtand in the evil Day, and having done all, may ſtand; having our Loins girt with Truth, and having the Breaſt-Plate of Righteouſneſs, and our Feet ſhod with the Preparation of the Goſpel of Peace. Above all, taking the Shield of Faith,*

Faith, and for an Helmet, the Hope of Salvation, and the Sword of the Spirit, which is the Word of God, Eph. vi. 13, 14.

He that with this Chriſtian Armour manfully fights againſt and repels the Temptations and Aſſaults of his Spiritual Enemies; he that keeps his Garments pure, and his Conſcience void of Offence towards God and towards Man, ſhall enjoy perfect Peace here, and Aſſurance for ever. *Tacitus* ſaith of the *Finni*, a Northern People, that they were *ſecuri adverſus homines, ſecuri adverſus Deos.* They need not fear what God or Man could do to them, becauſe they were in as bad a Condition as could conſiſt with living in the World: They could not be baniſhed into a worſe Country, nor put into worſe Circumſtances than they were in already. I might ſay of the Man that keeps a good Conſcience, that he is ſecure againſt God and Man; not in that Senſe the *Finni* were, but ſecure of any Evil befalling him from either. God can do him no Harm, not for want of Power, but for want of Will, which is regulated by his Truth and Juſtice. He is alſo ſecure in reſpect of Men, becauſe he is under the Protection of the Almighty: And if any there be that would do him Harm, they ſhall either be reſtrained by the Divine Providence, or if they be permitted to injure him, it ſhall tend only to the Exerciſe and Improvement of his Faith and Patience, and enhanſing his future

Reward at that great Day, when the Almighty ſhall diſpenſe *Aureolæ* to thoſe Champions who have ſignalized their Valour and Fidelity by Heroick Actions, or patient Sufferings of unworthy Things for his Sake. 3. A good Conſcience not only ſecures a Man from God and Men, but from himſelf too. *There is no Peace to the Wicked, ſaith my God*, no inward Peace. Such a Man is at odds with himſelf. For the Commandments of God being agreable to the Nature of Man, and perfectly conformable to the Dictates of right Reaſon; Man's Judgment gives Sentence with the Divine Law, and condemns him when he violates any of them; and ſo the Sinner becomes an *Heautontimorumenos*, a Tormentor of himſelf. *Prima eſt hæc ultio, quod ſe Judice nemo nocens abſolvitur.* No *guilty Perſon* is abſolved at his own Tribunal, himſelf being Judge.

Neither let any profligate Perſon, who hath bidden Defiance to his Conſcience, and is at War with himſelf, think to take Sanctuary in Atheiſm; and becauſe it imports him highly there ſhould be no God, ſtoutly deny that there is any. For firſt, ſuppoſing that the Exiſtence of a Deity were not demonſtrably or infallibly proved, (as it moſt certainly is,) yet he cannot be ſure of the contrary, that there is none. *For no Man can be ſure a* pure Negative, *namely, that ſuch a Thing is not, unleſs he will either pretend to have a certain Know-*

ledge

ledge of all Things that are or may be, than which nothing can be more monſtrouſly and ridiculouſly arrogant; or elſe, unleſs he be ſure that the Being of what he denies doth imply a Contradiction; for which there is not the leaſt Colour in this Caſe. The true Notion of God conſiſting in this, That he is a Being of all poſſible Perfection, that I may borrow my Lord Biſhop of *Cheſter's* Words, in his Diſcourſe of Natural Religion, *Page 94.*

Now if he be not ſure there is no Deity, he cannot be without ſome Suſpicion and Fear that there may be one.

Secondly, *If there ſhould be a Deity, ſo Holy, and Juſt, and Powerful, as is ſuppoſed, what Vengeance and Indignation may ſuch vile Miſcreants and Rebels expect, who have made it their Buſineſs to baniſh* Him *out of the World, who is the great Creator and Governor of it; to undermine his Being, and eradicate all Notions of Him out of their own and other Mens Minds; to provoke his Creatures and Vaſſals to a Contempt of him, a ſlighting of his Fear and Worſhip, as being ſuch imaginary* Chimæra's, *as are fit only to keep Fools in Awe? Certainly all this is the higheſt Provocation that any Man can be guilty of, ſo ſhall it be puniſhed with the ſoreſt Vengeance.*

Now a ſlender Suſpicion of the Exiſtence of a Being, the Denial whereof is of ſo ſad Conſequence, muſt needs diſturb the Atheiſt's Thoughts, and fill him with Fears, and quality and allay all his Pleaſures and Enjoyments, and render him miſerable even in this Life.

But, on the other ſide, he that believes and owns a God, if there ſhould be none, is in no Danger of any bad Conſequent. For all the Inconvenience of this Belief will be, that he may be hereby occaſioned to tye himſelf up to ſome needleſs Reſtraints during this ſhort Time of his Life, wherein notwithſtanding there is, as to the preſent, *much Peace, Quiet and Safety: And, as to the* future, *his Error ſhall die with him, there being none to call him to an Account for his Miſtake.* Thus far the Biſhop.

To which I ſhall add, that he not only ſuffers no Damage, but reaps a conſiderable Benefit from this Miſtake; for during this Life he enjoys a pleaſant Dream, or Fancy, of a future bleſſed Eſtate, with the Thoughts and Expectation whereof, he ſolaces himſelf, and agreably entertains his Time; and is in no Danger of being ever awakened out of it, and convinced of his Error and Folly, Death making a full End of him.

FINIS.

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